OMB Number: 2030-0020
Expiration Date: 06/30/2024

Preaward Compliance Review Report for All Applicants and Recipients Requesting EPA Financial Assistance

Note: Read Instructions before completing form.

I. A. Applicant/Recipient (Name, Address, City, State, Zip Code)

Name: The Research Foundation for SUNY, University at Albany

Address: 1400 Washington Avenue
MSC 100A

City: Albany

State: NY: New York Zip Code: 12222-0100

B. DUNS No. 152652822

II. Is the applicant currently receiving EPA Assistance? ☐ Yes ☒ No

III. List all civil rights lawsuits and administrative complaints pending against the applicant/recipient that allege discrimination based on race, color, national origin, sex, age, or disability. (Do not include employment complaints not covered by 40 C.F.R. Parts 5 and 7.)

- Alexander M. v. Cleary, et al., Index No. AD No. 528959 (NY Supreme Court, Appellate Division, Third Department) - Pending.
- Alaei, Kamiar v. UAlbany, et al., No. 1:21-cv-0037 (U.S. District Court, North District of New York) - Pending.
- COMPLAINANT NAME CONFIDENTIAL, OCR Case No. 02-21-2193 (U.S. Department of Education, Office for Civil Rights) - Pending.
- COMPLAINANT NAME CONFIDENTIAL, OCR Case No. 02-22-2020 (U.S. Department of Education, Office for Civil Rights) - Pending.
- COMPLAINANT NAME CONFIDENTIAL, OCR Case No. 02-20-2347 (U.S. Department of Education, Office for Civil Rights) - Pending.
- Heim v. Daniel, et al., No. 1:18-cv-00836 (U.S. District Court, North District of New York) - Pending.
- Pejovic, et al. v. UAlbany, et al.,No. 21-1927 (U.S. Court of Appeals, 2nd Circuit) - Pending.
- Willis v. New York State, State University of New York at Albany, DHR Case No. 10213333 (NY Division of Human Rights) - Pending.

IV. List all civil rights lawsuits and administrative complaints decided against the applicant/recipient within the last year that allege discrimination based on race, color, national origin, sex, age, or disability and enclose a copy of all decisions. Please describe all corrective actions taken. (Do not include employment complaints not covered by 40 C.F.R. Parts 5 and 7.)

None.

V. List all civil rights compliance reviews of the applicant/recipient conducted by any agency within the last two years and enclose a copy of the review and any decisions, orders, or agreements based on the review. Please describe any corrective action taken. (40 C.F.R. § 7.80(c)(3))

None.

VI. Is the applicant requesting EPA assistance for new construction? If no, proceed to VII; if yes, answer (a) and/or (b) below.

☐ Yes ☒ No

a. If the grant is for new construction, will all new facilities or alterations to existing facilities be designed and constructed to be readily accessible to and usable by persons with disabilities? If yes, proceed to VII; if no, proceed to VI(b).

☐ Yes ☐ No

b. If the grant is for new construction and the new facilities or alterations to existing facilities will not be readily accessible to and usable by persons with disabilities, explain how a regulatory exception (40 C.F.R. 7.70) applies.

VII. **Does the applicant/recipient provide initial and continuing notice that it does not discriminate on the basis of race, color, national origin, sex, age, or disability in its program or activities? (40 C.F.R 5.140 and 7.95)** ☒ Yes ☐ No

a. **Do the methods of notice accommodate those with impaired vision or hearing?** ☒ Yes ☐ No

b. **Is the notice posted in a prominent place in the applicant's offices or facilities or, for education programs and activities, in appropriate periodicals and other written communications?** ☒ Yes ☐ No

c. **Does the notice identify a designated civil rights coordinator?** ☒ Yes ☐ No

VIII. **Does the applicant/recipient maintain demographic data on the race, color, national origin, sex, age, or handicap of the population it serves? (40 C.F.R. 7.85(a))** ☒ Yes ☐ No

IX. **Does the applicant/recipient have a policy/procedure for providing access to services for persons with limited English proficiency? (40 C.F.R. Part 7, E.O. 13166)** ☒ Yes ☐ No

X. **If the applicant is an education program or activity, or has 15 or more employees, has it designated an employee to coordinate its compliance with 40 C.F.R. Parts 5 and 7? Provide the name, title, position, mailing address, e-mail address, fax number, and telephone number of the designated coordinator.**

Samuel Caldwell, MBA, Chief Diversity Officer and Assistant Vice President for Diversity and Inclusion; University Hall 207, 1400 Washington Avenue, Albany, NY 12222-0100, sjcaldwell@albany.edu; 518-956-8110

XI. **If the applicant is an education program or activity, or has 15 or more employees, has it adopted grievance procedures that assure the prompt and fair resolution of complaints that allege a violation of 40 C.F.R. Parts 5 and 7? Provide a legal citation or Internet Address for, or a copy of, the procedures.**

https://www.albany.edu/diversityandinclusion/equalopportunity.php

For the Applicant/Recipient

I certify that the statements I have made on this form and all attachments thereto are true, accurate and complete. I acknowledge that any knowingly false or misleading statement may be punishable by fine or imprisonment or both under applicable law. I assure that I will fully comply with all applicable civil rights statutes and EPA regulations.

A. Signature of Authorized Official	B. Title of Authorized Official	C. Date
Stefan Brooks	Senior Research Administrator	03/25/2022

For the U.S. Environmental Protection Agency

I have reviewed the information provided by the applicant/recipient and hereby certify that the applicant/recipient has submitted all preaward compliance information required by 40 C.F.R. Parts 5 and 7; that based on the information submitted, this application satisfies the preaward provisions of 40 C.F.R. Parts 5 and 7; and that the applicant has given assurance that it will fully comply with all applicable civil rights statures and EPA regulations.

A. *Signature of Authorized EPA Official	B. Title of Authorized Official	C. Date

*** See Instructions**

Instructions for EPA FORM 4700-4 (Rev. 06/2014)

General. Recipients of Federal financial assistance from the U.S. Environmental Protection Agency must comply with the following statutes and regulations.
Title VI of the Civil Rights Acts of 1964 provides that no person in the United States shall, on the grounds of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving Federal financial assistance. The Act goes on to explain that the statute shall not be construed to authorize action with respect to any employment practice of any employer, employment agency, or labor organization (except where the primary objective of the Federal financial assistance is to provide employment). Section 13 of the 1972 Amendments to the Federal Water Pollution Control Act provides that no person in the United States shall on the ground of sex, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under the Federal Water Pollution Control Act, as amended. Employment discrimination on the basis of sex is prohibited in all such programs or activities. Section 504 of the Rehabilitation Act of 1973 provides that no otherwise qualified individual with a disability in the United States shall solely by reason of disability be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving Federal financial assistance. Employment discrimination on the basis of disability is prohibited in all such programs or activities. The Age Discrimination Act of 1975 provides that no person on the basis of age shall be excluded from participation under any program or activity receiving Federal financial assistance. Employment discrimination is not covered. Age discrimination in employment is prohibited by the Age Discrimination in Employment Act administered by the Equal Employment Opportunity Commission. Title IX of the Education Amendments of 1972 provides that no person in the United States on the basis of sex shall be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any education program or activity receiving Federal financial assistance. Employment discrimination on the basis of sex is prohibited in all such education programs or activities. Note: an education program or activity is not limited to only those conducted by a formal institution. 40 C.F.R. Part 5 implements Title IX of the Education Amendments of 1972. 40 C.F.R. Part 7 implements Title VI of the Civil Rights Act of 1964, Section 13 of the 1972 Amendments to the Federal Water Pollution Control Act, and Section 504 of The Rehabilitation Act of 1973. The Executive Order 13166 (E.O. 13166) entitled; "Improving Access to Services for Persons with Limited English Proficiency" requires Federal agencies work to ensure that recipients of Federal financial assistance provide meaningful access to their LEP applicants and beneficiaries.

Items "Applicant" means any entity that files an application or unsolicited proposal or otherwise requests EPA assistance. 40 C.F.R. §§ 5.105, 7.25. "Recipient" means any entity, other than applicant, which will actually receive EPA assistance. 40 C.F.R. §§ 5.105, 7.25. "Civil rights lawsuits and administrative complaints" means any lawsuit or administrative complaint alleging discrimination on the basis of race, color, national origin, sex, age, or disability pending or decided against the applicant and/or entity which actually benefits from the grant, but excluding employment complaints not covered by 40 C.F.R. Parts 5 and 7. For example, if a city is the named applicant but the grant will actually benefit the Department of Sewage, civil rights lawsuits involving both the city and the Department of Sewage should be listed. "Civil rights compliance review" means any review assessing the applicant's and/or recipient's compliance with laws prohibiting discrimination on the basis of race, color, national origin, sex, age, or disability. Submit this form with the original and required copies of applications, requests for extensions, requests for increase of funds, etc. Updates of information are all that are required after the initial application submission. If any item is not relevant to the project for which assistance is requested, write "NA" for "Not Applicable." In the event applicant is uncertain about how to answer any questions, EPA program officials should be contacted for clarification. * Note: Signature appears in the Approval Section of the EPA Comprehensive Administrative Review For Grants/Cooperative Agreements & Continuation/Supplemental Awards form.

EPA KEY CONTACTS FORM

OMB Number: 2030-0020
Expiration Date: 06/30/2024

Authorized Representative: *Original awards and amendments will be sent to this individual for review and acceptance, unless otherwise indicated.*

Name: Prefix: | First Name: Paula | Middle Name:
Last Name: Kaloyeros | Suffix:
Title: Assistant Vice President for Sponsored Prog.

Complete Address:

Street1: 1400 Washington Avenue
Street2: MSC 100A
City: Albany | State: NY: New York
Zip / Postal Code: 12222-0100 | Country: USA: UNITED STATES
Phone Number: 518-437-4550 | **Fax Number:** 518-442-5208
E-mail Address: resadmin@albany.edu

Payee: *Individual authorized to accept payments.*

Name: Prefix: | First Name: Erin | Middle Name:
Last Name: Lupe | Suffix:
Title: Financial Reporting and Collections Manager

Complete Address:

Street1: 1400 Washington Avenue
Street2: MSC 100A
City: Albany | State: NY: New York
Zip / Postal Code: 12222-0100 | Country: USA: UNITED STATES
Phone Number: 518-437-3892 | **Fax Number:**
E-mail Address: elupe@albany.edu

Administrative Contact: *Individual from Sponsored Programs Office to contact concerning administrative matters (i.e., indirect cost rate computation, rebudgeting requests etc).*

Name: Prefix: Mr. | First Name: Stefan | Middle Name:
Last Name: Brooks | Suffix:
Title: Senior Research Administrator

Complete Address:

Street1: 1400 Washington Avenue
Street2: MSC 100A
City: Albany | State: NY: New York
Zip / Postal Code: 12222-0100 | Country: USA: UNITED STATES
Phone Number: 518-437-4557 | **Fax Number:** 518-442-5208
E-mail Address: sfbrooks@albany.edu

EPA Form 5700-54 (Rev 4-02)

EPA KEY CONTACTS FORM

Project Manager: *Individual responsible for the technical completion of the proposed work.*

Name: Prefix: Dr. First Name: Aynul Middle Name:

Last Name: Bari Suffix:

Title: Assistant Professor

Complete Address:

Street1: 1400 Washington Avenue

Street2: BIO 228

City: Albany State: NY: New York

Zip / Postal Code: 12222-0100 Country: USA: UNITED STATES

Phone Number: 518-437-4933 **Fax Number:**

E-mail Address: mbari@albany.edu

Project Narrative File(s)

*** Mandatory Project Narrative File Filename:** 1234-Project_Narrative_EPA AQ monitoring-3-25-22_RFSUN

Add Mandatory Project Narrative File | Delete Mandatory Project Narrative File | View Mandatory Project Narrative File

To add more Project Narrative File attachments, please use the attachment buttons below.

Add Optional Project Narrative File | Delete Optional Project Narrative File | View Optional Project Narrative File

Other Attachment File(s)

*** Mandatory Other Attachment Filename:** 1235-Other_Attachments_EPA_AQ_monitoring-3-25-22_R

Add Mandatory Other Attachment | Delete Mandatory Other Attachment | View Mandatory Other Attachment

To add more "Other Attachment" attachments, please use the attachment buttons below.

Add Optional Other Attachment | Delete Optional Other Attachment | View Optional Other Attachment

BUDGET INFORMATION - Non-Construction Programs

OMB Number: 4040-0006
Expiration Date: 02/28/2022

SECTION A - BUDGET SUMMARY

Grant Program Function or Activity (a)	Catalog of Federal Domestic Assistance Number (b)	Estimated Unobligated Funds		New or Revised Budget		
		Federal (c)	Non-Federal (d)	Federal (e)	Non-Federal (f)	Total (g)
1. Promoting sustainable air quality at underserved neighborhoods in New York State through low-cost sensor monitoring	66.034	$	$	$ 499,939.00	$ 20,573.00	$ 520,512.00
2.						
3.						
4.						
5. Totals		$	$	$ 499,939.00	$ 20,573.00	$ 520,512.00

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SECTION B - BUDGET CATEGORIES

6. Object Class Categories	GRANT PROGRAM, FUNCTION OR ACTIVITY (1)	(2)	(3)	(4)	Total (5)
	Promoting sustainable air quality at underserved neighborhoods in New York State through low-cost sensor monitoring				
a. Personnel	$ 82,346.00	$	$	$	$ 82,346.00
b. Fringe Benefits	10,625.00				10,625.00
c. Travel	8,648.00				8,648.00
d. Equipment	109,095.00				109,095.00
e. Supplies	1,400.00				1,400.00
f. Contractual	25,000.00				25,000.00
g. Construction	0.00				0.00
h. Other	147,176.00				147,176.00
i. Total Direct Charges (sum of 6a-6h)	384,290.00				$ 384,290.00
j. Indirect Charges	115,649.00				$ 115,649.00
k. TOTALS (sum of 6i and 6j)	$ 499,939.00	$	$	$	$ 499,939.00
7. Program Income	$	$	$	$	$

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Prescribed by OMB (Circular A -102) Page 1A

SECTION C - NON-FEDERAL RESOURCES

(a) Grant Program	(b) Applicant	(c) State	(d) Other Sources	(e)TOTALS
8. Promoting sustainable air quality at underserved neighborhoods in New York State through low-cost sensor monitoring	$ 20,573.00	$ 0.00	$ 0.00	$ 20,573.00
9.				
10.				
11.				
12. TOTAL (sum of lines 8-11)	$ 20,573.00	$ 0.00	$ 0.00	$ 20,573.00

SECTION D - FORECASTED CASH NEEDS

	Total for 1st Year	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
13. Federal	$ 294,452.00	$ 73,613.00	$ 73,613.00	$ 73,613.00	$ 73,613.00
14. Non-Federal	$ 20,573.00	20,573.00	0.00	0.00	0.00
15. TOTAL (sum of lines 13 and 14)	$ 315,025.00	$ 94,186.00	$ 73,613.00	$ 73,613.00	$ 73,613.00

SECTION E - BUDGET ESTIMATES OF FEDERAL FUNDS NEEDED FOR BALANCE OF THE PROJECT

(a) Grant Program	FUTURE FUNDING PERIODS (YEARS) (b)First	(c) Second	(d) Third	(e) Fourth
16. Promoting sustainable air quality at underserved neighborhoods in New York State through low-cost sensor monitoring	$ 294,452.00	$ 119,661.00	$ 85,826.00	$
17.				
18.				
19.				
20. TOTAL (sum of lines 16 - 19)	$ 294,452.00	$ 119,661.00	$ 85,826.00	$

SECTION F - OTHER BUDGET INFORMATION

21. Direct Charges: 384,290

22. Indirect Charges: Pred., MTDC Base: 205,419, IDC: 115,649

23. Remarks:

OMB Number: 4040-0004
Expiration Date: 12/31/2022

Application for Federal Assistance SF-424

* 1. Type of Submission:
- [ ] Preapplication
- [x] Application
- [ ] Changed/Corrected Application

* 2. Type of Application:
- [x] New
- [ ] Continuation
- [ ] Revision

* If Revision, select appropriate letter(s):

* Other (Specify):

* 3. Date Received: 03/25/2022

4. Applicant Identifier: NHH3T1Z96H29

5a. Federal Entity Identifier:

5b. Federal Award Identifier:

State Use Only:

6. Date Received by State:

7. State Application Identifier:

8. APPLICANT INFORMATION:

* a. Legal Name: The Research Foundation for SUNY, University at Albany

* b. Employer/Taxpayer Identification Number (EIN/TIN): 14-1368361

* c. Organizational DUNS: 1526528220000

d. Address:

* Street1: 1400 Washington Avenue
Street2: MSC 100A
* City: Albany
County/Parish: Albany
* State: NY: New York
Province:
* Country: USA: UNITED STATES
* Zip / Postal Code: 12222-0100

e. Organizational Unit:

Department Name: Sponsored Programs Admin.

Division Name: Division for Research

f. Name and contact information of person to be contacted on matters involving this application:

Prefix: Mr.
* First Name: Stefan
Middle Name:
* Last Name: Brooks
Suffix:

Title: Senior Research Administrator

Organizational Affiliation: The Research Foundation for SUNY, University at Albany

* Telephone Number: 518-437-4550
Fax Number: 518-442-5208

* Email: resadmin@albany.edu

Application for Federal Assistance SF-424

*** 9. Type of Applicant 1: Select Applicant Type:**

M: Nonprofit with 501C3 IRS Status (Other than Institution of Higher Education)

Type of Applicant 2: Select Applicant Type:

Type of Applicant 3: Select Applicant Type:

* Other (specify):

*** 10. Name of Federal Agency:**

Environmental Protection Agency

11. Catalog of Federal Domestic Assistance Number:

66.034

CFDA Title:

Surveys, Studies, Research, Investigations, Demonstrations, and Special Purpose Activities Relating to the Clean Air Act

*** 12. Funding Opportunity Number:**

EPA-OAR-OAQPS-22-01

* Title:

Enhanced Air Quality Monitoring for Communities

13. Competition Identification Number:

Title:

14. Areas Affected by Project (Cities, Counties, States, etc.):

Add Attachment | Delete Attachment | View Attachment

*** 15. Descriptive Title of Applicant's Project:**

Promoting sustainable air quality at underserved neighborhoods in New York State through low-cost sensor monitoring, integrated measurement, and community engagement

Attach supporting documents as specified in agency instructions.

Add Attachments | Delete Attachments | View Attachments

Application for Federal Assistance SF-424

16. Congressional Districts Of:

* a. Applicant: NY-020 * b. Program/Project: NY-020

Attach an additional list of Program/Project Congressional Districts if needed.

Add Attachment | Delete Attachment | View Attachment

17. Proposed Project:

* a. Start Date: 11/01/2022 * b. End Date: 10/31/2025

18. Estimated Funding ($):

* a. Federal	499,939.00
* b. Applicant	20,573.00
* c. State	0.00
* d. Local	0.00
* e. Other	0.00
* f. Program Income	0.00
* g. TOTAL	520,512.00

*** 19. Is Application Subject to Review By State Under Executive Order 12372 Process?**

☐ a. This application was made available to the State under the Executive Order 12372 Process for review on .

☐ b. Program is subject to E.O. 12372 but has not been selected by the State for review.

☒ c. Program is not covered by E.O. 12372.

*** 20. Is the Applicant Delinquent On Any Federal Debt? (If "Yes," provide explanation in attachment.)**

☐ Yes ☒ No

If "Yes", provide explanation and attach

Add Attachment | Delete Attachment | View Attachment

21. *By signing this application, I certify (1) to the statements contained in the list of certifications and (2) that the statements herein are true, complete and accurate to the best of my knowledge. I also provide the required assurances** and agree to comply with any resulting terms if I accept an award. I am aware that any false, fictitious, or fraudulent statements or claims may subject me to criminal, civil, or administrative penalties. (U.S. Code, Title 218, Section 1001)**

☒ ** I AGREE

** The list of certifications and assurances, or an internet site where you may obtain this list, is contained in the announcement or agency specific instructions.

Authorized Representative:

Prefix: Mr. * First Name: Stefan

Middle Name:

* Last Name: Brooks

Suffix:

* Title: Senior Research Administrator

* Telephone Number: 518-437-4557 Fax Number: 518-437-4550

* Email: sfbrooks@albany.edu

* Signature of Authorized Representative: Stefan Brooks * Date Signed: 03/25/2022

Manifest for Grant Application # GRANT13580209

Grant Application XML file (total 1):

1. GrantApplication.xml. (size 27121 bytes)

Forms Included in Zip File(total 6):

1. Form ProjectNarrativeAttachments_1_2-V1.2.pdf (size 16137 bytes)

2. Form SF424_3_0-V3.0.pdf (size 24348 bytes)

3. Form SF424A-V1.0.pdf (size 23500 bytes)

4. Form EPA4700_4_3_0-V3.0.pdf (size 23251 bytes)

5. Form OtherNarrativeAttachments_1_2-V1.2.pdf (size 15916 bytes)

6. Form EPA_KeyContacts_2_0-V2.0.pdf (size 37379 bytes)

Attachments Included in Zip File (total 2):

1. ProjectNarrativeAttachments_1_2 ProjectNarrativeAttachments_1_2-Attachments-1234-Project_Narrative_EPA AQ monitoring-3-25-22_RFSUNY_Final.pdf application/pdf (size 731024 bytes)

2. OtherNarrativeAttachments_1_2 OtherNarrativeAttachments_1_2-Attachments-1235-Other_Attachments_EPA_AQ_monitoring-3-25-22_RFSUNY_Final.pdf application/pdf (size 3396297 bytes)

I. Cover Page

- **Project Title:**
  Promoting sustainable air quality at underserved neighborhoods in New York State through low-cost sensor monitoring, integrated measurement, and community engagement
- **Applicant Information:**
  - Project Manager (PM) and PI: Md. Aynul Bari, Department of Environmental & Sustainable Engineering, University at Albany
  - Co-PI: Scott Miller, Atmospheric Science Research Center, University at Albany
  - Co-PI: Sarah Lu, Atmospheric Science Research Center, University at Albany
  - Co-PI: Brian Pavilonis, City University of New York (CUNY), School of Public Health
  - Applicant organization: The Research Foundation for SUNY, University at Albany
  - Address: 1400 Washington Avenue, MSC 100A, Albany, NY 12222
  - Primary contact: Stefan Brooks, 518-437-4557, resadmin@albany.edu
  - DUNS number: 152652822
- **Set-aside:** no set-aside
- **Brief Description of Applicant Organization:**

The Research Foundation for the State University of New York, (RFSUNY) is a separate 501(c)(3) organization from the State University of New York (SUNY), which meets the eligibility requirement in the RFA. RFSUNY provides fiscal and administrative services to SUNY.

- **Project Partners:**
  - Bard College Community Science lab: Elias Dueker
  - AVillage Inc. (Eva Bass) and United Way of the Greater Capital Region (Peter Gannon)
  - City of Kingston: Julie Noble
  - Hudson Valley Air Quality Coalition: Lorraine Farina/Citizens for Local Power (S. Gillespie)
  - Conservation Advisory Council of the City of Newburgh: Chuck Thomas
  - Outdoor Promise: Ronald Zorrilla
  - Restaurant Opportunity Center-NY (Prabhu Sigamani)/Harlem Health Initiative (D. Levine)
- **Project Locations:**
  - Capital District: South End, Albany, NY 12202; Schenectady, NY 12303, Cohoes, NY 12047
  - Hudson Valley Region: Kingston, NY 12401, Poughkeepsie, NY 12601, Newburgh, NY 12550
  - New York City (NYC): Harlem, Manhattan, NY 10026, 10027, 10036, 10037, 10039
- **Air Pollutant Scope:**
  - Ambient air monitoring: Black carbon (BC), ozone (O_3), nitrogen dioxide (NO_2), particulate matter (PM_1/$PM_{2.5}$/PM_{10})
  - Outdoor/indoor monitoring: BC, carbon monoxide (CO), O_3, total volatile organic compounds (TVOC), carbon dioxide (CO_2), air toxics
- **Budget Summary:**

EPA Funding Requested	Total Project Cost
$499,939	$520,512

- **Project Period:** 11/1/2022 – 10/31/2025
- **Short Project Description:** The main objective of this project is to improve air quality and public health across underserved neighborhoods in New York State (NYS). Activities include leveraging low-cost sensor monitoring to determine far-field (ambient) and near-field exposure (outdoors, indoors) and engage and empower community stakeholders. Expected outputs include community-specific problem identification and a comprehensive real-time hourly 2-year ambient data set with expected outcomes to reduce ambient and indoor air concentrations.

II. **Workplan**

Section 1 – Project Summary and Approach

A. Overall Project

Project summary

Objectives: Climate change can affect the air we breathe in both ambient and indoor environments. In the U.S., current ambient air quality observation networks are limited in characterizing the diverse group of air pollutants including climate-driven pollutant black carbon and air toxics that affect exposure across regional to neighborhood scales. Studies indicate that minority and low-income communities of color are disproportionally burdened with exposure to air pollution. The overarching goal of this three-year project is to improve air quality and public health across underserved neighborhoods in New York State (NYS) by establishing a community-driven network platform to enhance understanding of sustainable outdoor and indoor air quality. The specific objectives are to: 1) leverage exiting air quality monitoring expertise in low-cost sensor technology, 2) harness Internet of Things (IoT)-driven low-cost sensor monitoring to determine far-field (ambient) and near-field exposure (outdoors, indoors) at underserved communities, and 3) engage and empower community stakeholders to establish a foundation of trusting relationship and enhanced understanding for sustainable solutions. The key hypotheses are, ambient and near-field outdoor concentrations of air pollutants can vary spatially and temporally and have strong localized signals by nearby sources. To meet the objectives, the PIs will bring together residents of different neighborhoods in the Core Capital Region, Hudson Valley Region and New York City (NYC), including Environmental Justice (EJ) communities, and community organizations to develop a community air quality program which will serve as a model for other U.S. States.

Approach: Key approaches include 1) leveraging IoT-driven low-cost sensor monitoring in at least 21 fixed sites over a 2-year period to measure spatiotemporal variation of ambient air pollutants (including black carbon, O_3, NO_2 and $PM_1/PM_{2.5}/PM_{10}$), 2) identifying and engaging community stakeholders, 3) developing building capacity and knowledge of local air quality by arranging workshops and webinars, 4) measuring outdoor (backyard) and indoor air concentrations for consecutive 7 days in 4 to 6 homes of each neighborhood to collect seasonal data over 1-year period from at least 200 homes at neighborhoods including in or near underserved communities, 5) time-integrated outdoor and indoor sampling for air toxics at neighborhood communities, and 6) identifying impacts of local and regional sources through receptor and source-oriented modeling.

Expected Results: Expected outputs from this project include 1) a comprehensive real-time hourly 2-year ambient data set of targeted air pollutants (black carbon, O_3, NO_2 and $PM_1/PM_{2.5}/PM_{10}$), 2) hourly outdoor and indoor dataset of targeted air pollutants for one-week and time-integrated dataset for selected air toxics for communities and other stakeholders, 3) an improved understanding of community-specific air quality problems and local/regional source impacts, and 4) promotion of community engagement through workshops/webinars and information exchanges. Expected outcomes include 1) increased knowledge and understanding of air quality problems, 2) increased community awareness, 3) increased accessed to information, 4) enhanced understanding of sources of air pollutants and reduction of human health risk, 5) increased environmental stewardship and community action to reduce air emissions, and 6) reduction of ambient and indoor air concentrations and human exposure to certain air pollutants. Findings of this project will support policy makers for developing appropriate management initiatives to improve air quality at underserved communities.

Proposed activities

The following section outlines the research design, methods and techniques that have been proposed to meet the objectives stated above.

Task 1: Leveraging low-cost sensor monitoring for ambient fixed site air monitoring

To increase public awareness and address community-specific air quality issues, an enhanced air quality monitoring network for communities will be developed in and near underserved neighborhoods in NYS Capital District, Hudson Valley Region, and NYC. The selected pollutants are: black carbon (BC), O_3, NO_2, and particulate matter fractions ($PM_1/PM_{2.5}/PM_{10}$). BC is a known potent short-lived climate pollutant and an important component of particulate matter emitted from fossil fuel combustion (e.g., diesel engines) and biomass burning (e.g., wood stoves) and it has linked to adverse health outcomes. To measure spatiotemporal variation in targeted ambient air pollutants, a relatively low-cost ($4,100) BC detector (ObservAir, Distributed Sensing Technologies-DST, Caubel et al., 2019) coupled with other three pollutants (O_3, NO_2, PM) will be integrated to create a citizen science tool 'multipollutant sensor monitor'. PM fractions will be also measured using low-cost PurpleAir sensors.

Air quality sensors will be deployed over a 2-year period at 21 fixed sampling sites in the Capital District, Mid- and Lower-Hudson Region, and in NYC (Fig. 1). Out of 21 sites, 9 sites (four letter coded) will be selected (two in the Capital Region, 2 in Hudson Valley Region and 5 in NYC) from NYS Mesonet weather stations.

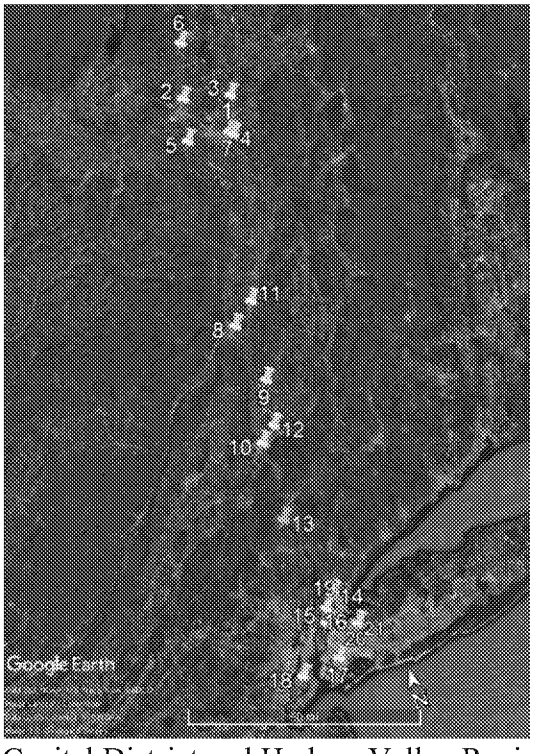


Fig. 1. Selected ambient fixed air quality monitoring sites (1. Albany South End, 2. Schenectady, 3. Cohoes, 4. Rensselaer, 5. VOOR- Voorheesville, 6. BSPA-Ballston Spa, 7. Ref. site1-Albany County Health Department, 8. Kingston, 9. Poughkeepsie, 10. City of Newburgh, 11. REDH-Red Hook, 12. BEAC-Beacon, 13. Ref. site2-Rockland, 14. BRON-Bronx, 15. MANH: Manhattan, 16. QUEE-Queens, 17. BKLN-Brooklyn, 18. STAT-Staten Island, 19. Harlem, 20. Ref. site3-Queens College near-road, 21. Ref. site4-Queens College)

A publicly accessible website will be built and shared with different stakeholders and local communities to show real-time concentrations of measured air pollutants. This will provide underserved communities information about the current state of local air quality in their neighborhoods.

Preliminary data: The PI Bari recently received the EPA Region 2 Citizen Science Purple Air Loan for Academic Institutions and will carry out an exploratory study (May 2022 – April 2023) to generate preliminary data for $PM_1/PM_{2.5}/PM_{10}$ at 12 selected sites in the Capital District and Hudson Valley Region (Fig. 1).

Task 2: Identifying and engaging community stakeholders

The PIs plan to initiate a broach range of methods and techniques for identifying and engaging community stakeholders. These include outreach, consultation, involvement, collaboration, and shared relationship (see section 2B community engagement). The PIs have selected some community partners in the study regions and will identify more micro-level community organizations to engage communities.

Task 3: Developing building capacity and empowering communities

The PIs plan to choose a number of ways to build community power to improve air quality.

- *Community meetings*: We will conduct knowledge translation activities via monthly meeting with community partners to engage community towards trust building.
- *Training and technology transfer*: We will organize training workshops (every 6 months in year 1 and 2 in each region), via which community participants will gain air quality design challenge, skills and competencies that enable them to assess air quality issues.
- *Technical assistance:* We will provide technical support related to low-cost sensors deployment, identify/solve problems or issues and/or to participate more effectively in decision making processes.
- *Community-based participatory research:* We will develop opportunities for research, where community residents participate in designing studies, interpreting findings, and presenting results to policymakers.
- *Empowerment approaches:* We will advocate for empowerment approaches to enhance community capacity in defining problem and implementing solutions.

Task 4: Harnessing low-cost sensors for outdoor and indoor air quality monitoring

To enhance understanding of community-specific near-field (outdoors in home backyard and indoors) air quality exposure, a community air quality monitoring will be performed in underserved neighborhoods in NYS Capital District, Hudson Valley Region, and NYC. The PI will leverage existing multipollutant sensor monitors to conduct outdoor and indoor air monitoring. At residential neighborhoods, we will deploy sensors (Table 1) outdoors in backyards for one-week period (consecutive 7 days) to measure real-time concentrations of particulate and gaseous pollutants e.g., BC, CO, NO_2, O_3, $PM_1/PM_{2.5}/PM_{10}$, TVOC and CO_2. As complementary measures, we will also conduct weekly indoor monitoring and measure BC, CO, $PM_1/PM_{2.5}/PM_{10}$, TVOC, CO_2, and ultrafine particles. We will conduct outdoor and indoor air sampling in 4-6 homes in each neighborhood with repeated measurements in some homes to collect data from at least 200 homes over a 2-year period across neighborhoods including underserved communities in the Core Capital District (e.g., Albany South End, Cohoes, Schenectady, Rensselaer, and Saratoga), Hudson Valley Region (Kingston, Poughkeepsie, City of Newburgh) and in the Harlem neighborhood in NYC. Data on meteorological parameters e.g., wind speed, wind direction will be also collected at each neighborhood using 3D Ultrasonic Anemometer (Young model 81000). Outdoor sampling will be performed in the backyard (where available) and as far away from any combustion sources e.g., barbeques, automobiles, and other localized outdoor sources as possible. Indoor measurements will be taken at a breathing height of 1.5 m within the family or living room. We will submit application for the Institutional Review Board (IRB) approval for indoor monitoring.

Table 1. List of available sensor monitors and other units for outdoor/indoor monitoring

Sensor devices	Available units	Environment	Key pollutants to be measured
Black carbon detectors (ObservAir, DST)	8	Outdoors, indoors	BC, CO, NO_2
DUET sensors (TelosAir)	8	Outdoors, indoors	TVOC, CO_2, $PM_1/PM_{2.5}/PM_{10}$
Air Things View Plus	4	Indoors	$PM_{2.5}$, TVOC, CO_2
PurpleAir sensors	8	Outdoors, indoors	$PM_1/PM_{2.5}/PM_{10}$
Aeroqual Series 500 O_3 monitor	1	Outdoors	O_3
Q-Trak 7575 (TSI)	1	Indoors	CO, CO_2
P-Trak 8525 (TSI)	1	Indoors	Ultrafine particles
3D Ultrasonic Anemometer (Young model 81000)	1	Outdoors	Wind speed, wind direction
Mini-Vol portable air sampler (AirMetries)	1	Outdoors, indoors	gravimetric $PM_{2.5}$
Resilient portable GC (Kindwell)	1	Outdoors, indoors	Speciated VOC (air toxics)
LC-MS/MS (Agilent 6470 triple quadrupole MS coupled with 1290 UHPLC)	1	Outdoors, indoors	air toxics (PAHs)

Preliminary results: Under UAlbany's Strategic Allocation of Resources (StAR) program (internal grants of $28,732) to address diversity and environmental justice, the PI Bari started outdoor and indoor air quality campaigns from November 2021 and already collected data from 24 homes in the Capital District and Hudson Valley Region including EJ communities and have plan to collect data from further 24 homes within summer 2022. Fig. 2 shows one-week outdoor (backyard) and indoor (living room) hourly concentrations of black carbon measured at 4 homes in Kingston, NY. Outdoor concentrations were significantly higher (paired *t*-test, p <0.0001) than indoors suggesting an influence of potential local sources contributing to BC levels at the underserved neighborhood.

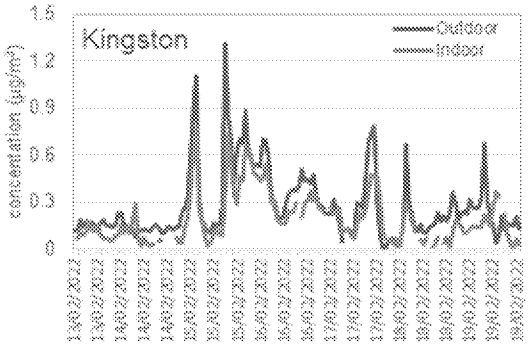


Fig.2. Example of 1-hr outdoor and indoor BC concentrations at an underserved community in Kingston.

Task 5: Determine heterogeneity in outdoor and indoor concentrations of air toxics

To characterize air toxics exposure among neighborhoods, time-integrated (24-48 hr) air filter samples will be collected from at least 100 homes both outdoors (where available) and indoors in the study regions using portable mini-Vol air samplers (Airmetrics). Collected filter samples will be analyzed for speciated VOCs including air toxics using portable GC (Kindwell, Inc) and polycyclic aromatic hydrocarbons (PAHs) using LC-MS-MS (Agilent) at PI's lab (Table 1).

Task 6: Air quality characterization, source identification and health risk assessment

The study will investigate temporal patterns (e.g., diurnal trends, weekday-weekend effects, seasonal patterns) and spatial variability (e.g., within and between neighborhoods, hot spot, urban vs rural/EJ communities) of BC and other pollutants. To identify local source impacts, a receptor modeling tool conditional bivariate probability function (CBPF) will be applied using real-time hourly concentrations and meteorological data (e.g., wind direction, wind speed). For air toxics, a multivariate USEPA receptor model positive matrix factorization (PMF) will be applied to identify outdoor and indoor sources. To assess the potential public health risk posed by exposure to air toxics and associated sources, a deterministic screening human health risk assessment of the inhalation exposure pathway will be also performed.

Task 7: Air quality modeling-local versus regional source impacts

The Weather Research and Forecasting Model with Chemistry (WRF-Chem) will be applied to advance process-level understanding of pollutant formation and distributions in the Capital District, Hudson Valley, and NYC region. WRF-Chem Integrated Process Rate (IPR) and Integrated Reaction Rate (IRR) analysis (Kumar et al., 2015) will be utilized to disentangle the contribution of individual physical and chemical processes to changes in pollutants in the three regions. The source contribution analysis, based on the tagged tracer approach (Emmons et al., 2012), will be used to track the contributions of selected emission sources (e.g., source sectors, source regions, and source types) to the formation of pollutants in the three regions. The emission-based source apportionment results calculated from the WRF-Chem simulations will complement the receptor-based source apportionment results calculated from the ambient observations.

B. Project Significance

The proposed project will generate new knowledge on climate-driven pollutant BC and other gaseous and particulate air pollutants as well as air toxics by creating a community air quality framework at underserved neighborhoods across NYS. Several local environmental problems exist

among neighborhood communities in the selected study region. For example, in the Capital Region, Albany South End neighborhood (population of ~5,000) is located near the Port of Albany having several facilities for transferring and storing petroleum, gasoline, and ethanol. There has been growing public health concerns among residents living in the South End communities e.g., Ezra Prentice neighborhood. The Hudson Valley region is an industrial hub and is known for its poor air quality in NYS. The EPA designated a number of counties (e.g., Rockland) as non-attainment areas and high O_3 days were also observed in Dutchess and Orange counties. Wintertime residential wood burning is also a known issue in the Hudson Valley communities such as Kingston (population ~24,000). In addition to known water contamination issue, residents living in the City of Newburgh (population ~28,000) have potential concerns about poor air quality from industrial operations e.g., Danskammer Generating Station. Last but not least, NYC is the most densely populated city in the U.S. with ~8.5 million inhabitants within its five boroughs (Brooklyn, Queens, Manhattan, Bronx, and Staten Island) and is a known EPA non-attainment area for O_3, where communities are potentially vulnerable to different environmental burdens.

A community or a society achieves a sustainable air quality when our air quality meets the National Ambient Air Quality Standards (NAAQS) and when air pollutants pose no significant threat to sensitive populations. The proposed project will address research gaps in understanding both far-field (ambient) and near-field (outdoors, indoors) air quality exposure by leveraging recent advances in sensor technology to better elucidate on-going health and environmental concerns in underserved communities in the study regions. The work is innovative because it provides (1) the first evaluation of a comprehensive real-time hourly data set of BC and other pollutants as well as time-integrated dataset for selected air toxics at underserved communities, (2) an improved understanding of spatiotemporal variation, local sources and associated health risks, and (3) enhanced understanding of contribution of neighborhood and regional emission sources. The outcomes of this project can benefit the general people to improve their knowledge, raise awareness and empower communities to take actions to reduce exposure from air pollutants and reduce health care cost by improving outdoor and indoor air quality and health.

Section 2 – Community Involvement

A. Community Partnerships

The PIs will engage and make partnerships with different community organizations, city government and Conservation Advisory Councils to promote sustainable air quality among underserved communities. The planned roles of each community partner will be to:

- Assist in conducting questionnaire surveys and to understand community needs and concerns and conducting polls for feedback to understand community priorities
- Assist in planning and designing outdoor/indoor air monitoring, home recruitment
- Provide community data and resources to help researchers interpret with the community context
- Assist in arranging community meetings/webinars for educating the community and raising awareness about air quality issues
- Assist in measuring performance of the project

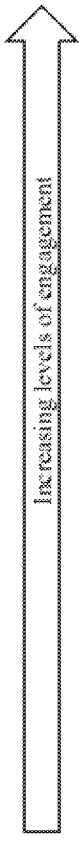
As a member of this partnership, each partner will get benefits by increasing community awareness, increased understanding of pollutants levels, local sources and reduction measures to certain air pollutants and promoting environmental stewardship for potential sustainable solutions to improve air quality and the health of residents in their communities.

The PIs will plan to maintain and sustain these relationships into the future through:

- attending monthly meetings of the community organizations to get updates and concerns
- continue particulate matter monitoring at all fixed sites using low-cost PurpleAir sensors

B. Community Engagement

Fig. 3. Shows community engagement plan to understand how we engage with and develop partnership with identified and targeted communities to effectively perform the project.



Variable	Definition	Activities
Shared leadership	formed strong partnership structures and final decision-making is at the community level	- create forums to bring community leaders together to consider air quality issues - enable and empower community leaders to make a decision
Collaborate	increased community involvement, bi-directional communication and formation of partnership with community on each aspect of project from development to solution	- use web-based engagement processes (facebook, twitter) to exchange views - conduct knowledge translation activities (monthly/quarterly meeting with community partners) to engage community towards trust building - co-design and plan ideas and solutions with community members - organize online/in-person training workshops for discussions and facilitate deliberation
Involvement	better community involvement with participatory form of communication	- provide opportunities for community scholars and citizen science researchers by deploying sensors - collect data and analyze them with regards to community context - discuss and review findings with community members to help them make informed decisions
Consultation	more community involvement to seek answer and get feedbacks from the community	- conduct questionnaire surveys to better understand community needs and concerns - conduct polls for feedback to understand community priorities - leverage community partner tools and select the champions from community
Outreach	limited community involvement to provide information to community	- reaching out to underserved community champions, leaders, faith-based leaders, federal, state and local agencies, advocates and concerned residents to increase awareness about air pollution.

Fig. 3. Community engagement continuum

The PI Bari has recent involvement with project partners (e.g., Bard College, AVillage Inc.) and residents particularly in the Capital District and Hudson Valley Region for ongoing outdoor/indoor air quality study.

The PIs plan to build a publicly accessible website for presenting real-time ambient air monitoring data for 2 years and share with different stakeholders and local communities. The outdoor/indoor monitoring data and individual reports with recommendations to reduce pollutants' exposure will be also shared to each community participants within three months after collection.

Section 3 – Environmental Justice and Underserved Communities

Table 2 shows EJ indexes, pollution and sources, and socioeconomic indicators of selected

Table 2. Characterization of selected EJ communities (%tile in State versus %tile in USA)

Variables	Albany South	Schenectady	Kingston	Poughkeepsie	Newburgh	Bronx County	New York County	Queens County	Kings County
EJ Index-$PM_{2.5}$	71 (74)	60 (63)	61 (64)	67 (70)	78 (79)	89 (88)	65 (69)	76 (77)	73 (76)
EJ Index-O_3	72 (75)	60 (64)	62 (65)	68 (72)	79 (81)	89 (88)	64 (68)	75 (78)	72 (75)
EJ Index-traffic proximity	81 (87)	62 (70)	69 (77)	78 (85)	72 (79)	93 (95)	82 (87)	84 (89)	79 (85)
EJ Index-RMP facility proximity	96 (92)	60 (63)	61 (64)	86 (83)	94 (90)	89 (85)	81 (79)	73 (73)	84 (81)
Demographic Index	84 (87)	66 (71)	63 (68)	73 (79)	84 (87)	87 (90)	60 (64)	70 (76)	68 (75)
People of color	71 (79)	57 (62)	56 (60)	65 (72)	74 (83)	82 (90)	61 (67)	72 (80)	66 (74)
Low Income	89 (89)	81 (80)	77 (75)	82 (89)	85 (84)	83 (81)	56 (52)	59 (55)	71 (67)

underserved communities in the study regions retrieved from the EPA's EJSCREEN tool. Most of all selected communities are marked as low-income ones being affected by traffic and RMP facility proximity with the national percentiles over 80%. The proposed study will provide benefits to these communities by using publicly available real-time ambient data and share information through knowledge translation activities to engage them towards trust building. Through outdoor and indoor air quality monitoring across 200 homes among communities, the study will ensure their meaningful participation with respect to design, planning and performance of the project.

Section 4 – Environmental Results – Outcomes, Outputs and Performance Measures

A. Expected Project Outputs and Outcomes

Table 3. Outputs and outcomes of the proposed project

Outputs	Outcomes		
	Short-term a change in knowledge	**Intermediate-term** a change in behavior	**Long-term** a change in conditions
• Identification of community-specific air quality issue	• Identification of community-specific air quality problems	• Increased critical thinking ability and decision making about air quality issues	• Establishment of long-term air quality measurement plan
• Deployment of low-cost multipollutant sensors for air quality monitoring in and near underserved communities	• Increased community awareness about air quality problems	• Community neighborhoods start making decisions to improve air quality	• Improved understanding of outdoor and indoor air quality issues
• A comprehensive real-time publicly accessible hourly 2-year ambient data and weekly outdoor/indoor dataset for communities and stakeholders	• Increased access to information and tools for understanding reduction of air pollution and public health risks	• State and local policy and mitigation actions for certain air pollutants	• Improved environmental stewardship and community action to reduce air emissions
• Promotion of community engagement through workshops/webinars and information exchange	• Increased knowledge and understanding of near-field (outdoors, indoors) air quality issues	• Specific actions and/or practices are adopted by communities to improve air quality	• Reduction of ambient and outdoor/indoor air concentrations and human exposure to certain pollutants.

B. Performance Measures and Plan

The PIs plan to initiate a number of approaches to increase the likelihood that the project will proceed on schedule and ensure the timely and efficient expenditure of grant funds.

Setting up clear expectations for performance

- Make sure about contract detail e.g., performance timelines, interim milestone, expected short-term, medium-term and long-term project outcomes.
- Set up expectations for reporting and accounting with partners
- Provide suggestions and share best practices to help partners administer and implement their activities efficiently.

Monitoring project implementation and spending

- Check from time to time to oversee overall program spending.
- Evaluate progress by reporting on spending at project/stakeholder meetings.
- Develop expenditure schedules, review them quarterly and follow up on discrepancies.
- Monitor partners' performance and progress and provide technical assistance if needed.
- Explain subrecipients or subawardees about the importance of timely performance and how their spending contributes to the PI's overall performance.

C. Timeline and Milestones

Table 4. Timeline and milestones of the proposed project

Milestones/Quarter	Year 1				Year 2				Year 3			
	1	2	3	4	5	6	7	8	9	10	11	12
Milestone 1 Ambient air community monitoring												
Milestone 2 Community engagement*												
Community meetings**												
Training workshops-Capital District/Hudson Valley												
Training workshops -NYC												
Milestone 3. Outdoor/indoor community monitoring												
Capital District/Hudson Valley												
NYC-Harlem neighborhood												
Milestone 4 Quality assurance of low-cost sensors												
Performance evaluation-Ambient air data												
Performance evaluation-outdoor/indoor air data												
Milestone 5 Assessment of ambient air quality												
Milestone 6 Assessment of outdoor/indoor air quality												
Milestone 7 Assessment of outdoor/indoor air toxics												
Milestone 8 Local source impacts-receptor modeling												
Milestone 9 WRF-Chem modeling												
Milestone 10 Final Report												
Milestone 11 Journal manuscripts												

*As needed, **monthly meeting during outdoor/indoor monitoring (e.g., Q3-6) and quarterly afterwards

Section 5 – Quality Assurance Statement (see attachment)

Section 6 – Programmatic Capability and Past Performance

A. Past Performance: PI is an early career researcher, and he has no past performance.

B. Reporting Requirements: None

C. Staff Expertise: PI Md. Aynul Bari has more than 12 years of experience in assessing air quality issues in urban and rural areas across Canada (Alberta), Europe (Germany, Cyprus) and USA (NY). He is currently leading indoor and outdoor air quality study in NYS Capital Region (internal grant) and co-leading fine-scale monitoring in NYC using low-cost sensors (funded by New York State Energy Research and Development Authority- NYSERDA). **Co-PI Scott Miller** has expertise in instrumentation and field measurements. He has overseen the design, deployment, and operation of the 18 NYSM (New York State Mesonet) "flux sites" and is currently leading (with Drs. Lu and Bari) a NYSERDA project to deploy ~40 custom low-cost air quality sensor packages at NYC metro area. **Co-PI Sarah Lu** has expertise in regional air quality modeling. She is the lead PI for the development of an air quality forecasting system for real-time aerosol detection and monitoring, in New York State and co-leads the low-cost air quality sensors at NYSM/NYCM sites (both funded by NYSERDA). **Co-PI Brian Pavilonis** has expertise in industrial hygiene and exposure science, and he is currently leading and co-leading several environment health studies.

Reference:

Caubel et al., 2019. A Distributed Network of 100 Black Carbon Sensors for 100 Days of Air Quality Monitoring in West Oakland, California. *Environ. Sci. Technol.* 53, 7564–7573.

Emmons et al., 2012 Tagged ozone mechanism for MOZART-4, CAM-chem and other chemical transport models. Geosci Model Dev 5(6),1531–1542.

Kumar et al., 2015. What controls the seasonal cycle of black carbon aerosols in India? J. Geophys. Res.: Atmos., 120(15), 7788–7812. doi:10.1002/2015JD023298, 2015.

Section 7 – Budget

Budget Detail and Reasonableness of Costs

- **Personnel** – **Md. Aynul Bari**, PhD, Department of Environmental and Sustainable Engineering (ESE), University at Albany, State University of New York, is the PM and PI and he will supervise and lead all aspects of the project. Dr. Bari will devote 0.30 months (3%) of effort during the summer of each year of the project. Dr. Bari's annual salary is projected at $109,982 and the salary rate increases 2% each year. The total salary request is $11,220. **Sarah Lu, PhD,** Atmospheric Sciences Research Center, University at Albany, is a Co-Principal Investigator and she will apply the Weather Research and Forecasting Model with Chemistry (WRF-Chem) and contribute to manuscript preparation. Dr. Lu will devote 0.25 months (~3%) of effort during the summer of each year of the project. Dr. Lu's annual salary is projected at $58,289; the salary rate increases 2% each year. The total salary request is $4,955. **Scott Miller PhD,** Atmospheric Sciences Research Center, University at Albany, is a Co-Principal Investigator and he will maintain ambient fixed site monitoring including NYS Mesonet sites, assist in calibration, validation and performance measurements. Dr. Miller will devote 0.25 months (~3%) of effort during the summer per year and his annual salary is projected at $123,413 with the rate increases 2% each year. The total request is $10,491. **Zahirul Khan, PhD,** Department of ESE, University at Albany, is a senior person on this project and he will assist in identifying and engaging communities. Dr. Khan will devote 0.30 months (3%) of summer effort per year. Dr. Khan's annual salary is $48,960, and the salary rate increases 2% each year. The total request is $4,995. **Other Personnel** – The budget includes two **graduate assistants (GA)** throughout all three years of the project during the academic year of each year ($38,984). The GA1 will work with the PI and devote 25% of time (10 hours per week) throughout all three years of the project. The GA2 will work with Dr. Lu for 5 hours per week during the academic year of Year 3. The GA1 will assist in managing fixed ambient monitoring sites in the Capital Region (e.g., changing filters bi-weekly for black carbon detectors), conducting weekly field campaign for outdoor/indoor air quality monitoring at neighborhoods, analyzing sensor data and performing lab analysis of collected filters for air toxics. The GA2 will assist Dr. Lu in applying air quality modeling (WRF-Chem). The budget also includes one **undergraduate research assistant** during the academic year (10 hours per week) of Year 1 and the summer of Year 2 for 20 hours per week ($11,701). The undergraduate student will work closely with the PI and the GA1 to assist in outdoor/indoor air quality monitoring.
- **Fringe Benefits** – The proposed federally negotiated fringe benefit rates for The Research Foundation for The State University of New York, University at Albany are as follows: 14% in Years 1, 14.17% (weighted average of FY24 and FY25) in Year 2, and 14.5% in in Year 3 for faculty summer salary; 13% in Years 1, 13.50% (weighted average of FY24 and FY25) in Year 2, and 14.67% (weighted average of FY25 and FY26) in Year 3 for the graduate assistant; and 6% for all three years of the project for the undergraduate assistant. The fringe benefits include medical and dental insurance, retirement, workers compensation, disability insurance, and PTO.
- **Travel** – Travel costs of $8,648 are requested for domestic travel (Year 1: $1,200, Year 2: $3,724, Year 3: $3,724) for the entire project duration (three years). In Years 2 and 3, the PI or the graduate student will attend one domestic conference such as AGU Fall Meeting ($2,524/person/trip: Airfare, $600; Registration, $585; Ground transportation, parking, and incidentals, $100; Lodging, $134 x 6 days = $804; M&IE, $79 x 4 days, $59.25 x 2 days = $434.50) to present research and establish future collaboration. For local transport, $100 per month is allocated for managing fixed air monitoring sites (bi-weekly filter changing) in the

Capital Region, attending meetings/workshops, outreach and outdoor/indoor air monitoring for homes. A 2% increase for the travel costs are included in Years 2 and 3 to allow for inflation.

- **Equipment** – Funds of $109,095 are requested in Year 1 to purchase 21 units of ObservAir multipollutant monitors (for measuring black carbon, ozone, nitrogen dioxide and particulate matter) with unit cost of $5,195 which includes necessary accessories (e.g., enclosure with environmental control, PV panel, power bank, replacement filters, and dedicated portal).
- **Supplies** – Funds of $1,400 are requested in Year 1 to purchase 120 glass fibre filters ($100), two PurpleAir sensors ($500) and VOC/PAH standards ($800).
- **Contractual** - $25,000 is included to pay for the involvement of community partners and all partners will receive under $5,000 each.
- **Other Direct Costs — Subawards: The City University of New York** will participate in this project as a subawardee, and their total budget is $74,884. The co-PI Dr. Pavilonis at CUNY Graduate School of Public Health and Health Policy (CUNY SPH) will devote 0.30 months (3%) of effort during the summer of each year of the project. One SPH graduate student will provide research assistance. They will deploy and manage air sampling equipment at 7 fixed sites including bi-weekly filter changing, work with local community groups to recruit home participants and conduct outdoor/indoor monitoring at least 50 homes.

  Bard College will participate in this project as a subawardee, and their total budget is $44,892. Through the community Sciences Lab in the Center for Environmental Sciences and Humanities (CESH), Bard College will provide technical and analytical support for the Hudson Valley communities (e.g., Kingston, Poughkeepsie, and Newburgh), manage fixed air monitoring sites and conduct outdoor/indoor monitoring at least 50 homes. $5,000 is budgeted to pay to get access for Mesonet weather data, which is necessary for this project. $8,400 is included to cover cost of data plan with WiFi hotspots ($200/year per site, Year 1: $4,200, Year 2: $4,200). $4,500 is included ($1,500 in each year) to pay for community meeting logistics, which is necessary to identify and engage communities. $6,000 is budgeted ($3,000 in each of the first two years) to give gift cards ($30) to 200 home participants to conduct air quality monitoring, which covers power supply and survey completion. $3,500 is included in Year 3 to pay for publication costs.

  Direct Costs – The total direct costs of this project are $384,290.
- **Indirect Costs** – Facilities and administrative costs of 56.2% in Year 1 (weighted average of FY23 and FY24) and 56.5% in Years 2 and 3 are calculated on a Modified Total Direct Cost base in accordance with our Department of Health and Human Services federally negotiated indirect cost rate agreement dated March 25, 2021. In accordance with this agreement, tuition and Equipment are excluded when calculating the total direct cost base. The indirect cost base is $205,419 and the total indirect costs for this project are $115,649.

Total Amount Requested – The sum of the direct and indirect costs of this project are $499,939.

Voluntary Non-Federal Cost Share – PI will provide $15,573 to cover cost of one personal data ram (pdr-1500) (for indoors, $7,000), 13 PurpleAir sensors (for fixed sites, $3,263) and 3 Aeroqual S500 O_3 sensors (for outdoors, $5,310). Additionally, our subawardee, Bard College, will provide $5,000 to cover part of the cost for the two Onset HOBO MicroRX Weather Station w/cellular logger, solar panel, and tripod kits.

Expenditure of Awarded Funds – The RFSUNY's post-award administration will manage all aspects e.g., review of grant expenditures to ensure compliance, payment of vendor invoices, financial reporting and billing to sponsors, distribution of payroll charges, and documentation of cost sharing. The PI Bari will ensure the external partner expended the grant fund in a timely and efficient manner.

Budget Table

Line Item & Itemized Cost	EPA Funding	Non-Federal Funding	Total Project Costs
Personnel			
(1) Project Manager and Principal Investigator, Dr. Aynul Bari @ $76.72/hr avg. x 146.25 hrs	$ 11,220	$0	$ 11,220
(2) Co-Principal Investigator, Dr. Sarah Lu @$40.66/hr avg. x 120.9 hrs	$ 4,955	$0	$ 4,955
(3) Co-Principal Investigator, Dr. Scott Miller @$86.08/hr avg. x 120.9 hrs	$ 10,491	$0	$ 10,491
(4) Senior Personnel, Dr. Zahirul Khan @$34.15/hr avg. x 146.25 hrs	$ 4,995	$0	$ 4,995
(5) Graduate Student 1, @$29.50/hr avg. x 1,080 hrs	$ 31,859	$0	$ 31,859
(6) Graduate Student 2, @$27.40/hr x 260 hrs	$ 7,125	$0	$ 7,125
(7) Undergraduate Student, @$15.45/hr avg. x 760 hrs	$ 11,701	$0	$ 11,701
TOTAL PERSONNEL	$ 82,346	$0	$ 82,346
Fringe Benefits			
Fringe Benefits Faculty Summer	$ 4,504	$0	$ 4,504
Fringe Benefits Graduate Assistants	$ 5,419	$0	$ 5,419
Fringe Benefits Undergraduate Assistants	$ 702	$0	$ 702
TOTAL FRINGE BENEFITS	$ 10,625	$0	$ 10,625
Travel			
AGU Fall Meeting - $2,524/person/trip: Airfare, $600; Registration, $585; Ground transportation, parking, and incidentals, $100; Lodging, $134 x 6 days = $804; M&IE, $79 x 4 days, $59.25 x 2 days = $434.50).	$ 5,048	$0	$ 5,048
Local transport, $100 per month is allocated for managing fixed air monitoring sites (bi-weekly filter changing) in the Capital Region, attending meetings/workshops, outreach activities and outdoor/indoor air monitoring for homes	$ 3,600	$0	$ 3,600
TOTAL TRAVEL	$ 8,648	$0	$ 8,648
Equipment			
21 units of ObservAir multipollutant monitors (for measuring black carbon, ozone, nitrogen dioxide and particulate matter) with unit cost of $5,195	$ 109,095	$0	$ 109,095
One personal data ram (pdr-1500) (for indoors, $7,000), 13 PurpleAir sensors (for fixed sites, $3,263) and 3 Aeroqual S500 O3 sensors (for outdoors, $5,310).	$0	$15,573	$ 15,573
TOTAL EQUIPMENT	$ 109,095	$15,573	$ 124,668
Supplies			
120 glass fibre filters ($100), 2 PurpleAir sensors ($500), and VOC/PAH standards ($800)	$ 1,400	$0	$ 1,400
TOTAL SUPPLIES	$ 1,400	$0	$ 1,400
Contractual			
Micropurchases - involvement of community partners. All partners will receive under $5,000 each.	$ 25,000	$0	$ 25,000
TOTAL CONTRACTUAL	$ 25,000	$0	$ 25,000
Other			
Subawards			
The Research Foundation for The City University of New York (CUNY)	$ 74,884	$0	$ 74,884
Bard College	$ 44,892	$5,000	$ 49,892
Campus recharges (Mesonet data)	$ 5,000	$0	$ 5,000
Data plan (wifi hotspot with data plan)	$ 8,400	$0	$ 8,400
Community Meeting Logistics	$ 4,500	$0	$ 4,500
Home Study Participant Incentives	$ 6,000	$0	$ 6,000
Publication Costs	$ 3,500	$0	$ 3,500
TOTAL OTHER	$ 147,176	$0	$ 152,176
Indirect Costs			
Federal Indirect Cost Rate x Personnel = Indirect Costs (Federal Negotiated Indirect Cost Rate)	$ 115,649	$0	$ 115,649
TOTAL INDIRECT	$ 115,649	$0	$ 115,649
TOTAL FUNDING	$ 499,939	$0	
TOTAL PROJECT COST	$ 499,939	$20,573	$ 520,512

Section 5 – Quality Assurance Statement

1. Identification of Principal Investigator

The PI (Md. Aynul Bari) will be a primarily responsible for the quality assurance (QA) and quality control (QC) aspects of this project. The PI is an assistant professor in the Department of Environmental & Sustainable Engineering, at University at Albany, SUNY. The PI is authorized to conduct research projects and train graduate students at UAlbany. The PI has more than 12 years of experience in assessing air quality issues in urban, suburban and rural areas at numerous locations across Canada (Alberta, Ontario), in Europe (Germany, Cyprus), and in the U.S. He was a leading researcher in the Health Canada funded indoor air quality study conducted in the Capital Region of Alberta (Edmonton) and investigated indoor and outdoor (backyard) air quality exposure among residential neighborhoods. The PI has extensive experience in measuring air pollutants using reference monitors and in performing QA/QC for all aspects of air quality measurements and determining acceptable data quality (e.g., precision, accuracy, representativeness, completeness or data quality objectives). This project will collect real-time hourly concentrations of BC, O_3, NO_2 and $PM_1/PM_{2.5}/PM_{10}$ using low-cost sensors at fixed ambient monitoring sites and time-integrated data of air toxics at outdoor and indoor homes.

Data quality assurance (QA) and quality control (QC): Ambient fixed site air quality monitoring. Data quality control is an important aspect for using low-cost sensors. The response of the low-cost sensors is highly sensitive to ambient temperature, humidity, pollutants mixture. High pollution loadings, local weather, and infrastructure conditions present unique challenges for low-cost sensors calibration, deployment, and maintenance. The proposed work will develop calibration models and a standard operational procedure (SOP) for low-cost sensors of target pollutants.

Multipollutant sensor calibration and data validation will be done by co-locating with reference monitors at Albany, Hudson Valley Region, and NYC. Black carbon sensor data measured from relatively low-cost detectors (ObservAir Series, Distributed Sensing Technology) will be validated by co-locating with reference monitors at Albany County Health Department (ref1-Magee Scientific Aethalometer Method 866) and in NYC near-road site at Queens College (ref 3-TAPI 633 Aethalometer Method 866). In general, ObserAir BC data showed good precision (r^2 ~1.0, between identical sensors collated at same sampling conditions) and accuracy (r^2 =0.85 – 0.89, co-located with reference monitors) (Caubel et al., 2022).

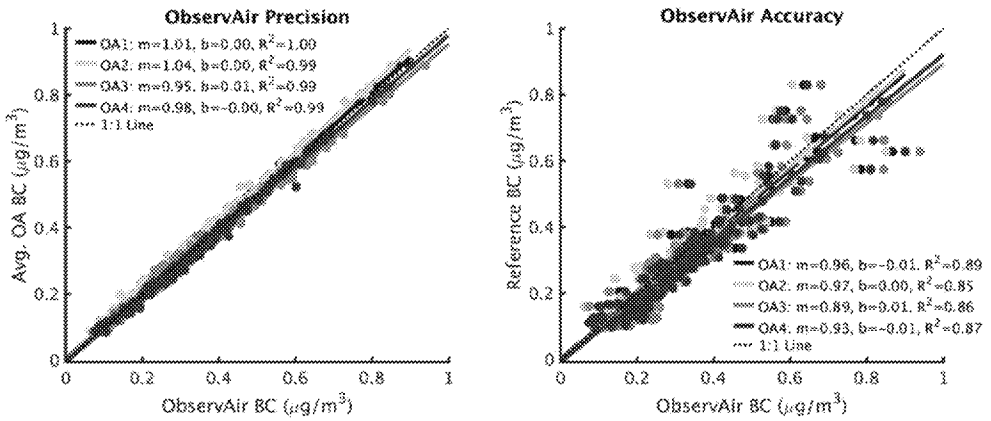


Fig. 4. Precision and accuracy of ObservAir BC sensor data (Caubel et al., 2022).

For QA/QC of O_3 and $PM_{2.5}$ data, the study will evaluate performance metrics protocols shown in Table 5 as recommended by USEPA (2021a,b). The study will use multi-variate linear

regression to calibrate low-cost O_3 and $PM_{2.5}$ data with reference concentrations (ref2-Rockland for O_3, ref4-Queens College for O_3 and $PM_{2.5}$) along with temperature and relative humidity.

Table 5. Performance metrics of O_3 and $PM_{2.5}$ (EPA, 2021)

Performance metrics		Target value	
		O_3	$PM_{2.5}$
Precision	Standard deviation (SD)	≤ 5 ppbv	≤ 5 μg/m^3
	Coefficient of variation (CV)	≤ 30%	≤ 30%
Bias	Slope	1.0 ± 0.2	1.0 ± 0.35
	Intercept (b)	-5 ≤ b ≤ 5 ppbv	-5 ≤ b ≤ 5 μg/m^3
Accuracy/linearity	Coefficient of determination (R^2)	≥ 0.80	≥ 0.70
Error	Rood mean squared error (RMSE)	≤ 5 ppbv	≤ 7 μg/m^3
	Normalized Root Mean Square Error (NRMSE)		≤ 30%

Most low-cost PM sensors use optical measurement techniques and show low correlation with regulatory-grade instruments. With increasing ambient humidity, hygroscopic growth of particles occurs, leading to increased light scattering coefficient and resulting mass concentrations. In this study, we will perform corrections and both seasonal and long-term performance evaluation for $PM_{2.5}$ sensors.

QA/QC: Outdoor and indoor air quality monitoring

Unlike ambient air monitoring, validation measurements of low-cost indoor and outdoor (backyard) sensors are challenging due to required logistic and unavailability of reference monitors in indoor settings. Indoor and outdoor ObservAir BC data will be compared with microAethalometer MA 300 (Aeth labs, CA), which generally shows good performance with reference BC monitors. Low-cost $PM_{2.5}$ Plantower sensor (PMS5003) data will be calibrated using personal Data Ram pDR-1500 (Thermo Scientific), which has been used as a reference device for other personal sensors, indoor settings and compared well with gravimetric methods (Sousan et al., 2016).

QA/QC: Indoor and outdoor air toxics

Collected time integrated filter samples will be analyzed using portable GC (Kindwell, Inc) and LC-MS/MS (Agilent) and EPA standard operating protocol and quality control procedures will be used to determine concentrations of air toxics. Instrument calibration will be done with reference standards and precision analysis will be performed using duplicate measurements.

Reference:

Caubel, J., Wang, X., Cados, T., Watson, J., Chow, J., 2022. Combustion-focused Air Quality Monitoring with Sensor Networks. Presentation in the A&WMA (Air & Waste Management Association) Air Measurements Conference, March 2022.

Duvall, R., A. Clements, G. Hagler, A. Kamal, Vasu Kilaru, L. Goodman, S. Frederick, K. Johnson Barkjohn, I. VonWald, D. Greene, T. Dye., 2021a. Performance Testing Protocols, Metrics, and Target Values for Ozone Air Sensors: Use in Ambient, Outdoor, Fixed Site, Non-Regulatory and Informational Monitoring Applications. U.S. EPA Report, EPA/600/R-20/279.

Duvall et al., 2021b. Performance Testing Protocols, Metrics, and Target Values for Fine Particulate Matter Air Sensors: Use in Ambient, Outdoor, Fixed Site, Non-Regulatory Supplemental and Informational Monitoring Applications. U.S. EPA report, EPA/600/R-20/280.

Sousan, S.; Koehler, K.; Thomas, G.; Park, J. H.; Hillman, M.; Halterman, A.; Peters, T. M. Inter-Comparison of Low-Cost Sensors for Measuring the Mass Concentration of Occupational Aerosols. Aerosol Sci. Technol. 2016, 50 (5), 462−473.

SUNY RF
The Research Foundation for
The State University of New York

Proof of Nonprofit Status

Office of General Counsel & Secretary

35 State Street
Albany, New York

Mailing Address:
Post Office Box 9
Albany, New York
12201-0009

(T) 518.434.7045
(F) 518.935.6707

www.rfsuny.org

January 18, 2022

Re: The Research Foundation of State University of New York
Confirmation of IRC 501(c)(3) Tax Exempt Status

To Whom It May Concern:

The Research Foundation for The State University of New York (the "Foundation") is a private, non-profit corporation and is an organization described in Internal Revenue Code Section 501(c)(3). Enclosed for your information is the April 11, 2008, determination letter in which the Internal Revenue Service concluded the Foundation qualified for exemption from federal income taxes. As of the date of this letter, the determination remains unchanged.

The Foundation has been a tax-exempt organization under Internal Revenue Code since its inception in 1951.

The Foundation's public charity status is identified as an organization exempt from Federal Income Tax under Internal Revenue Code Section 509(a)(1) of the code.

If you have further questions concerning this subject, please do not hesitate to contact me at (518) 434-7045.

Sincerely,

DocuSigned by:
C100611B11C6400...

Christopher L. Ashley
General Counsel & Secretary

Internal Revenue Service
Director, Exempt Organizations
Rulings and Agreements

Date: APR 11 2008

Department of the Treasury
P.O. Box 2508
Cincinnati, Ohio 45201

Employer Identification Number:
14-1368361
Person to Contact - ID#:
Sirijun Mayi - #31-07372
Contact Telephone Number:
877-829-5500 Phone
Public Charity Status:
509(a)(1) and 170(b)(1)(A)(vi)

The Research Foundation of State
University of New York
c/o Brian K Haynes
Bond, Schoeneck & King PLLC
One Lincoln Center
Syracuse, NY 13202-1355

Dear Applicant:

Our letter dated November 7, 1951 stated that you were exempt from Federal income tax under section 501(c)(3) of the Internal Revenue Code and classified as a public charity under sections 509(a)(1) and 170(b)(1)(A)(iv) and later modified to section 509(a)(3) of the Code.

Based on the information you submitted, we have modified your public charity status to the Code section listed in the heading of this letter. The effective date of your reclassification is July 1, 2007. Since your exempt status was not under consideration, you continue to be classified as an organization exempt from Federal income tax under section 501(c)(3) of the Code.

Publication 557, Tax-Exempt Status for Your Organization, provides detailed information about your rights and responsibilities as an exempt organization. You may request a copy by calling the toll-free number for forms, 800-829-3676. Information is also available on our Internet Web Site at www.irs.gov.

We have sent a copy of this letter to your representative as indicated in your power of attorney.

Because this letter could help resolve any questions regarding your exempt status, you should keep it in your permanent records.

If you have any questions, please call our toll free number shown in the heading of this letter.

Sincerely,

Robert Choi
Director, Exempt Organizations
Rulings and Agreements

Section 6 – Optional Attachments

1. Partnership Letters

Subawardee: CUNY Graduate School of Public Health and Health Policy, Co-PI Brian Pavilonis

CUNY SPH

The Research Foundation for SUNY
University at Albany
1400 Washington Avenue, Albany, NY 12222

March 20, 2022

RE: Partnership letter of Commitment for the EPA Enhanced Air Quality Monitoring for Communities (RFA Number: EPA-OAR-OAQPS-22-01)

Dear Aynul,

If the proposal submitted by the Research Foundation for SUNY, entitled **"Promoting sustainable air quality at underserved neighborhoods in New York State through low-cost sensor monitoring, integrated measurement and community engagement"** is selected for funding by the EPA, the CUNY Graduate School of Public Health and Health Policy (CUNY SPH) will collaborate and commit resources as outlined in the Project Description of the proposal.

Specially, our role would be to:

- support fixed site ambient air quality monitoring in NYC by setting up equipment and changing filters for black carbon measurements
- Assist in neighborhood selection/home recruitment, installation of sensors, and weekly measurements for both outdoor and indoor air quality monitoring
- Support data collection and help researchers to interpret with the community context
- Assist in educating the community and raising awareness about air quality issues

We are excited at the potential outcomes of this EPA project and look forward to working with the Research Foundation for SUNY.

Sincerely,

Brian Pavilonis Ph.D. CIH
Associate Professor
Department of Environmental, Occupational, and Geospatial Health Sciences
CUNY Graduate School of Public Health and Health Policy
55 W. 125th Street, New York, NY 10027

Subawardee: Bard College, Dr. Elias Dueker

BARD

A College of the Liberal Arts and Sciences *Division of Science, Mathematics, and Computing*

The Research Foundation for SUNY
University at Albany
1400 Washington Avenue, Albany, NY 12222

March 24, 2022

RE: Partnership letter of Commitment for the EPA Enhanced Air Quality Monitoring for Communities (RFA Number: EPA-OAR-OAQPS-22-01)

Dear Aynul,

If the proposal submitted by the Research Foundation for SUNY, entitled **"Promoting sustainable air quality at underserved neighborhoods in New York State through low-cost sensor monitoring, integrated measurement and community engagement"** is selected for funding by the EPA, Bard's Community Sciences Lab, as part of the Center for Environmental Science and Humanities, will collaborate and commit resources as outlined in the Project Description of the proposal.

Specifically, our role would be to:

- Support fixed site ambient air quality monitoring in the Hudson Valley Region by setting up equipment and changing filters for black carbon measurements
- Assist in neighborhood selection/home recruitment, installation of sensors, and weekly measurements for both outdoor and indoor air quality monitoring.
- Support data collection and help researchers to interpret with the community context.
- Assist in educating the community and raising awareness about air quality issues.

Additionally, we will provide $5,000 in cost-share with the grant funds to purchase and install weather stations (as outlined in the proposal details) at both the Poughkeepsie and Newburgh study sites.

We are excited about the potential outcomes of this EPA project and look forward to working with the Research Foundation for SUNY on this and other air quality-focused projects in the future.

Sincerely,

M. Elias Dueker
Associate Professor, Biology & Environmental and Urban Studies
Director, Center for Environmental Sciences and Humanities
Director, Environmental and Urban Studies Program

PO Box 5000, Annandale-on-Hudson, NY 12504-5000 *Telephone: 845-758-6822*

Community partners: NYS Capital Region

- **AVillage Inc.: Eva Bass**

The Research Foundation for SUNY
University at Albany
1400 Washington Avenue, Albany, NY 12222

March 24, 2022

RE: Partnership letter of Commitment for the EPA Enhanced Air Quality Monitoring for Communities (RFA Number: EPA-OAR-OAQPS-22-01)

Dear Aynul,

If the proposal submitted by the Research Foundation for SUNY, entitled **"Promoting sustainable air quality at underserved neighborhoods in New York State through low-cost sensor monitoring, integrated measurement and community engagement"** is selected for funding by the EPA, it is our intent to collaborate and/or commit resources in this project.

Specially, our role would be to:

- Assist in conducting questionnaire surveys to understand community needs and concerns and conducting polls for feedback to understand community priorities
- Assist in planning and designing outdoor/indoor air monitoring at community neighborhoods
- Assist in neighborhood selection and home recruitment for both outdoor and indoor air quality monitoring
- Assist in arranging community meetings/webinars for educating the community and raising awareness about air quality issues
- Provide community data and other resources to the project
- Assist in measuring performance of the project

AVillage will share existing information and research conducted at Ezra Prentice Homes in Albany, NY, by our organization and others regarding the health of residents, as well as our involvement in an ongoing NYS Department of Environmental Conservation air quality study at that location and elsewhere in the South End of Albany. AVillage will also work with our contacts at Ezra Prentice to introduce researchers to potential research subjects for the above study.

In return, AVillage and our partners expect to be informed of results of this study as it relates to the health of residents in our community.

We look forward to working with you in this important project for our community.

Thank you.

Sincerely,
Signature

Eva Bass
Executive Director
AVillage Inc.

- **United Way of the Greater Capital Region: Peter Gannon**

United Way of the Greater Capital Region

1 Steuben Place
Albany, NY 12205
Tel: 518.456.2200
www.unitedwaygcr.org

United Way
of the Greater Capital Region

The Research Foundation for SUNY
University at Albany
1400 Washington Avenue, Albany, NY 12222

March 7, 2022

RE: Partnership letter of Commitment for the EPA Enhanced Air Quality Monitoring for Communities (RFA Number: EPA-OAR-OAQPS-22-01)

Dear Aynul,

If the proposal submitted by the Research Foundation for SUNY, entitled **"Promoting sustainable air quality at underserved neighborhoods in New York State through low-cost sensor monitoring, integrated measurement and community engagement"** is selected for funding by the EPA, it is our intent to assist you in building relationships with community-based organizations who may be able to assist in community outreach.

Air quality is one of the essential elements of green and healthy homes. We look forward to learning more about how the findings of this research project can be turned into actionable efforts to address social determinants of health for underserved households.

We look forward to working with you in this important project for our community.

Thank you.

Sincerely,

PETER GANNON
President & CEO

Community partners: Hudson Valley Region

- **City of Kingston: Julie Noble**

CITY OF KINGSTON

Office of the Mayor

mayor@kingston-ny.gov

Steven T. Noble
Mayor

March 10, 2022

The Research Foundation for SUNY
University at Albany
1400 Washington Avenue, Albany, NY 12222

RE: Partnership letter of Commitment for the EPA Enhanced Air Quality Monitoring for Communities (RFA Number: EPA-OAR-OAQPS-22-01)

Dear Aynul,

The City of Kingston is pleased to support the Bard proposal entitled **"Promoting sustainable air quality at underserved neighborhoods in New York State through low-cost sensor monitoring, integrated measurement and community engagement"** for funding by the EPA. It is our intent to collaborate and/or commit resources as outlined in the Project Description of the proposal.

Specifically, our role would be to:

- House air quality equipment on the Andy Murphy Neighborhood Center roof
- Support data collection and help researchers to interpret within the community context
- Assist in arranging community meetings/webinars for educating the community and raising awareness about air quality issues
- Provide community data and other resources to the project

In return, as a member of this partnership, we expect to get the benefits of increasing community awareness, increased understanding of pollutants levels, local sources of and reduction measures for certain air pollutants, and promoting environmental stewardship for potential sustainable solutions to improve air quality and the health of residents in our community.

We look forward to working with you in this important project for our community.

Thank you.

Sincerely,

Steven T. Noble
Mayor

- **Conservation Advisory Council of the City of Newburgh: Chuck Thomas**

Conservation Advisory Council | City of Newburgh, New York
123 Grand Street, Newburgh, New York, 12550
Phone: (845) 569-7380 e-mail:

The Research Foundation for SUNY
University at Albany
1400 Washington Avenue, Albany, NY 12222

March 8, 2022
RE: Partnership letter of Commitment for the EPA Enhanced Air Quality Monitoring for Communities (RFA Number: EPA-OAR-OAQPS-22-01

Dear Aynul,

If the proposal submitted by the Research Foundation for SUNY, entitled **"Promoting sustainable air quality at underserved neighborhoods in New York State through low-cost sensor monitoring, integrated measurement and community engagement"** is selected for funding by the EPA, it is our intent to collaborate and/or commit resources in this project.

Specially, our role would be to:

- assist in conducting questionnaire surveys to understand community needs and concerns and conducting polls for feedback to understand community priorities
- assist in arranging community meetings/webinars for educating the community and raising awareness about air quality issues
- assist in planning and designing outdoor/indoor air monitoring at community neighborhoods
- assist in neighborhood selection and home recruitment for both outdoor and indoor air quality monitoring
- provide community data and other resources to the project
- assist in measuring performance of the project

In return, as a member of this partnership, we expect to get benefits by increasing community awareness, increased knowledge and understanding of air quality problems, enhanced understanding of sources of air pollutants, and promoting environmental stewardship for potential sustainable solutions to improve air quality and the health of residents in our community.

We wish you success with your proposal and look forward to working with you in this important project for our community.

Thank you
Sincerely,

Chuck Thomas, Chair

- **Outdoor Promise: Ronald Zorrilla**

Outdoor Promise
217 Liberty Street #1465
Newburgh, NY 12550
(845) 288-0145
www.OutdoorPromise.org

March 19, 2022

The Research Foundation for SUNY
University at Albany
1400 Washington Avenue, Albany, NY 12222

RE: Partnership letter of Commitment for the EPA Enhanced Air Quality Monitoring for Communities (RFA Number: EPA-OAR-OAQPS-22-01)

Dear Aynul,

If the proposal submitted by the Research Foundation for SUNY, entitled **"Promoting sustainable air quality at underserved neighborhoods in New York State through low-cost sensor monitoring, integrated measurement and community engagement"** is selected for funding by the EPA, it is our intent to collaborate and/or commit resources in this project.

Specially, our role would be to:

- assist in conducting questionnaire surveys to understand community needs and concerns and conducting polls for feedback to understand community priorities
- assist in arranging community workshops/webinars for educating the community and raising awareness about air quality issues
- assist in planning and designing outdoor/indoor air monitoring at community neighborhoods
- assist in neighborhood selection and home recruitment for both outdoor and indoor air quality monitoring
- provide community data and other resources to the project
- assist in measuring the performance of the project

In return, as a member of this partnership, we expect to get benefits by increasing community awareness, increased knowledge and understanding of air quality problems, enhanced understanding of sources of air pollutants, and promoting environmental stewardship for potential sustainable solutions to improve air quality and the health of residents in our community.

We wish you success with your proposal and look forward to working with you on this important project for our community.

Thank you.

Sincerely,

Ronald Zorrilla
CEO - Outdoor Promise

- **Hudson Valley Air Quality Coalition (HVAQ): Lorraine Farina**

March 16, 2022

The Research Foundation for SUNY
University at Albany
1400 Washington Avenue, Albany, NY 12222

RE: Partnership letter of Commitment for the EPA Enhanced Air Quality Monitoring for Communities (RFA Number: EPA-OAR-OAQPS-22-01)

Dear Aynul:

Here at the Hudson Valley Air Quality Coalition (HVAQ), we are a small coalition of building scientists, environmental scientists, community organizers and leaders focused on addressing the pressing environmental justice issue of indoor and outdoor air pollution. We are very happy to support and participate in the important work of SUNY Albany and its partners to gain greater knowledge of neighborhood-scale indoor and outdoor air quality in the Hudson Valley.

If the proposal submitted by the Research Foundation for SUNY, entitled **"Promoting sustainable air quality at underserved neighborhoods in New York State through low-cost sensor monitoring, integrated measurement and community engagement"** is selected for funding by the EPA, it is our intent to collaborate as outlined in the Project Description of the proposal.

Specifically, our role would be to:

- Assist in conducting questionnaire surveys to understand community needs and concerns and conducting polls for feedback to understand community priorities
- Assist in planning and designing outdoor/indoor air monitoring at community neighborhoods
- Assist in neighborhood selection and home recruitment for both outdoor and indoor air quality monitoring
- Support data collection and help researchers to interpret with the community context
- Assist in arranging community meetings/webinars for educating the community and raising awareness about air quality issues
- Assist in measuring performance of the project

In return, as a member of this partnership, we look forward to increasing community awareness through communicating the data collected through this research project, which will include a deeper understanding of pollutants levels, an identification of local sources and reduction measures for certain air pollutants, and promoting environmental stewardship to improve air quality and the health of residents in our community.

We look forward to working with you on this important project for our community and the rest of the Hudson Valley. Thank you!

Sincerely,

Founding Members of HVAQ:
Ana Texeira, Community Leader and Organizer
Desiree Lyle, Building Scientist
Judith Karpova, Building Scientist
Lorraine Farina, Community Leader and Organizer
Eli Ducker, Environmental Microbiologist

- **Citizens For Local Power (CLP): Susan Gillespie**

March 22, 2022

The Research Foundation for SUNY
University at Albany
1400 Washington Avenue
Albany, NY 12222

RE: Partnership letter of Commitment for the EPA Enhanced Air Quality Monitoring for Communities (RFA Number: EPA-OAR-OAQPS-22-01)

To whom it may concern:

I write on behalf of Citizens for Local Power (CLP) to confirm our willingness to support the important work of the Hudson Valley Air Quality Coalition and SUNY Albany and its partners, with the objective of helping to gaining greater knowledge of neighborhood-scale indoor and outdoor air quality in the Hudson Valley. If the proposal submitted by the Research Foundation for SUNY, entitled **"Promoting sustainable air quality at underserved neighborhoods in New York State through low-cost sensor monitoring, integrated measurement and community engagement"** is selected for funding by the EPA, CLP will be glad to serve as fiscal sponsor for HVAQ's $4,000 stipend, as HVAQ carries out its role, including outreach and public education to support the air quality studies outlined in the Project Description of the proposal.

CLP looks forward to cooperating with SUNY Albany and other partners to help ensure the success of this important project for our community and the rest of the Hudson Valley.

Sincerely,

Susan H. Gillespie
President of the Board
Citizens for Local Power
EIN: 47-3531432

PO Box 6115, Kingston, NY 12402 | [illegible]

Community partners: New York City

- **CUNY SPH Harlem Health Initiative: Deborah Levine**

CUNY SPH

CUNY SPH HARLEM HEALTH INITIATIVE

The Research Foundation for SUNY
University at Albany
1400 Washington Avenue, Albany, NY 12222

March 22, 2022

RE: Partnership letter of Commitment for the EPA Enhanced Air Quality Monitoring for Communities (RFA Number: EPA-OAR-OAQPS-22-01)

Dear Aynul,

If the proposal submitted by the Research Foundation for SUNY, entitled **"Promoting sustainable air quality at underserved neighborhoods in New York State through low-cost sensor monitoring, integrated measurement and community engagement"** is selected for funding by the EPA, it is our intent to collaborate and/or commit resources as outlined in the Project Description of the proposal.

Specially, our role would be to:

- Assist in planning and designing outdoor/indoor air monitoring at community neighborhoods
- Assist in neighborhood selection and home recruitment for both outdoor and indoor air quality monitoring
- Support data collection and help researchers to interpret with the community context
- Assist in arranging community meetings/webinars for educating the community and raising awareness about air quality issues
- Assist in conducting questionnaire surveys to understand needs and concerns of residents and neighborhood communities related to air quality issues
- Provide community data and resources to the project
- Assist in measuring performance of the project

In return, as a member of this partnership, we expect to get benefits by increasing community awareness, increased understanding of pollutants levels, local sources and reduction measures to certain air pollutants and promoting environmental stewardship for potential sustainable solutions to improve air quality and the health of residents in our community.

We look forward to working with you in this important project for our community.

Thank you.

Sincerely,

Deborah A Levine

Deborah Levine
Director, CUNY SPH Harlem Health Initiative

- **Restaurant Opportunity Center-NY: Prabhu Sigamani**

ROC NEW YORK
RESTAURANT OPPORTUNITIES CENTER OF NEW YORK
275 7TH AVE, STE 1703 NEW YORK, NY 10001
ny@rocunited.org • (212) 343-1771

The Research Foundation for SUNY
University at Albany
1400 Washington Avenue, Albany, NY 12222

March 24, 2022

RE: Partnership letter of Commitment for the EPA Enhanced Air Quality Monitoring for Communities (RFA Number: EPA-OAR-OAQPS-22-01)

Dear Aynul,

If the proposal submitted by the Research Foundation for SUNY, entitled **"Promoting sustainable air quality at underserved neighborhoods in New York State through low-cost sensor monitoring, integrated measurement and community engagement"** is selected for funding by the EPA, it is our intent to collaborate and/or commit resources in this project.

Specially, our role would be to:

- assist in conducting questionnaire surveys to understand community needs and concerns and conducting polls for feedback to understand community priorities
- assist in neighborhood selection and home recruitment for both outdoor and indoor air quality monitoring
- assist in arranging community workshops/webinars for educating the community and raising awareness about air quality issues
- provide community data and other resources to the project
- assist in measuring performance of the project

In return, as a member of this partnership, we expect to get benefits by increasing community awareness, increased knowledge and understanding of air quality problems, enhanced understanding of sources of air pollutants, and promoting environmental stewardship for potential sustainable solutions to improve air quality and the health of residents in our community.

We wish you success with your proposal and look forward to working with you in this important project for our community.

Thank you.

Sincerely,

Rev. Prabhu Sigamani
Director, ROC-NY

Letter of support – NYS Department of Environmental Conservation (NYSDEC)

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

Division of Air Resources, Bureau of Air Quality Surveillance
625 Broadway, Albany, New York 12233-3256
P: (518) 402-8508 | F: (518) 402-9035
www.dec.ny.gov

March 22, 2022

Bari, Md. Aynul
Assistant Professor
Department of Environmental & Sustainable Engineering
College of Engineering and Applied Sciences
The Research Foundation for SUNY
University at Albany
1400 Washington Avenue, Albany, NY 12222
mbari@albany.edu

Dear Aynul:

I am writing to offer support for your proposal (in response to EPA-OAR-OAQPS-22-01) entitled "Promoting sustainable air quality at underserved neighborhoods in New York State through low-cost sensor monitoring, integrated measurement and community engagement".

We appreciate the ability to leverage existing DEC measurements for low-cost sensor calibration and validation measurements. The NYSDEC will work with you and your staff to install sensors at three of our monitoring sites in the Albany, Hudson Valley Region and New York City areas. NYSDEC staff will also provide hourly data for all available parameters and will assist with as much data interpretation as is necessary.

Additionally, the NYSDEC would appreciate an opportunity to provide comment on the final report. We look forward to the results of your monitoring and research and appreciate your continued collaboration with DEC researchers.

Sincerely,

Brian Lay, P.E.
Director
Bureau of Air Quality Surveillance
Division of Air Resources

NEW YORK STATE | Department of Environmental Conservation

Letter of support – NYS Mesonet

March 15, 2022

The Research Foundation for SUNY
University at Albany
1400 Washington Avenue, Albany, NY 12222

RE: Letter of Support for the EPA Enhanced Air Quality Monitoring for Communities (RFA Number: EPA-OAR-OAQPS-22-01)

Dear Aynul,

I am writing to offer support for your proposed EPA proposal (in response to EPA-OAR-OAQPS-22-01) entitled **"Promoting sustainable air quality at underserved neighborhoods in New York State through low-cost sensor monitoring, integrated measurement and community engagement"**. We appreciate the ability to leverage our existing Mesonet sites for low-cost sensor measurements. We will allow your team access to our monitoring sites for at least two in the Capital Region (Voorheesville, Ballston Spa), two in the Hudson Valley Region (Red Hook, Beacon) and five (Bronx, Manhattan, Queens, Brooklyn, and Staten Island) in the New York City areas. The Mesonet staff will also provide hourly meteorological data for all available parameters and will assist with as much data interpretation as is necessary.

We look forward to the results of your monitoring and research and appreciate your continued collaboration with us.

Sincerely,

Jerald Brotzge, PhD
Program Manager
NYS Mesonet

(518) 442-MESO | Lecture Center, Suite SB-38 | 1400 Washington Avenue | Albany, New York 12222

Letter of support – Distributed Sensing Technologies for multipollutant sensor monitors (black carbon, O_3, NO_2, and particulate matter)

Distributed Sensing Technologies

March 16, 2022
RE: Partnership Letter

The Research Foundation for SUNY
University at Albany
1400 Washington Avenue, Albany, NY 12222

March 11, 2022

RE: Partnership letter of Commitment for the EPA Enhanced Air Quality Monitoring for Communities (RFA Number: EPA-OAR-OAQPS-22-01)

Dear Aynul,

Our company, Distributed Sensing Technologies (DST), develops air quality measurement solutions for health monitoring and atmospheric research applications. If the proposal submitted by the Research Foundation for SUNY, entitled "**Promoting sustainable air quality at underserved neighborhoods in New York State through low-cost sensor monitoring, integrated measurement and community engagement**" is selected for funding by the EPA, it is our intent to collaborate and/or commit resources as outlined in the Project Description of the proposal.

Specifically, our role would be to promote sustainable air quality at underserved neighborhoods in New York State by providing the requisite hardware (sensors to measure air pollutants, such as black carbon, ozone, nitrogen dioxide and particulate matter) for enhanced air quality monitoring research.

We wish you success with your proposal and look forward to working with you.

Sincerely,

Julien Caubel, PhD
CEO and co-Founder, DST
Email: Julien@dstech.io
Phone: (646) – 596 – 3845
Address: 10 Hall Drive, Orinda, CA 94563

2. Resumes

PI: Md. Aynul Bari, Department of Environment & Sustainable Engineering, UAlbany
Assistant Professor
University at Albany, Department of Environmental & Sustainable Engineering
1400 Washington Avenue, BIO 228, Albany, NY 12222
Telephone: 518-437-4933, e-mail: mbari@albany.edu

Professional Preparation

Institution	Location	Degree	Dates
Bangladesh University of Engineering and Technology	Dhaka, Bangladesh	BSc, Civil Engineering	1995-2000
University of Stuttgart	Stuttgart, Germany	M.Sc., Environmental Engineering	2002-2004
University of Stuttgart	Stuttgart, Germany	PhD, Environmental Engineering	2004-2009
University of Alberta	Edmonton, Alberta	Research Associate, Air Quality	2011-2018

Positions and Appointments

Dec. 2009-Nov. 2010 NSERC Visiting Fellow, Environment and Climate Change Canada
2011-2013 Postdoctoral Fellow, School of Public Health, University of Alberta, Canada
2014-2018 Research Associate, School of Public Health, University of Alberta, Canada
2018- Assistant Professor, Department of Environmental & Sustainable Engineering, University at Albany, State University of New York

Research and Professions Experiences

Dr. Bari's current research focuses on understanding far-field (ambient) and near-field (outdoors, indoors) exposure and sources of criteria air pollutants, air toxics and emerging contaminants, evaluation of low-cost air pollution sensors, air quality trend analysis, source apportionment, assessment of local and long-range source impacts, and exposure risk assessment.

Relevant Publications (from 35 peer-reviewed journal articles) and presentations:

1. Paul, S., **Bari, M.A.**, 2022. Elucidating sources of VOCs in the Capital Region of New York State: Implications to secondary transformation and public health exposure. *Chemosphere (in press*).
2. Paul, S., Eugene, M., Pereira, R., Barak, F., Frank, B., **Bari, M.A**., 2022. Understanding heterogeneity and sources of black carbon in residential neighbourhoods in the Capital Region of New York State. Abstract in the Air Sensors International Conference, Pasadena, CA, May 11–13.
3. **Bari, M.A.**, Kindzierski, W.B., 2017. Concentrations, sources and human health risk of inhalation exposure to air toxics in Edmonton, Canada. *Chemosphere* 173, 160–171.
4. **Bari, M.A.**, Kindzierski, W.B., Wallace, L., MacNeill, M., Hérox, M.E., Wheeler, A.J., 2015. Indoor and outdoor levels and sources of sub-micron particulate matter (PM_1) at homes in Edmonton, Canada. *Environmental Science & Technology* 49, 6419–6429.
5. **Bari, M.A.**, Kindzierski, W.B., Wallace, L., MacNeill, M., Hérox, M.E., Wheeler, A.J., 2015. Source apportionment of indoor and outdoor volatile organic compounds at homes in Edmonton, Canada. *Building and Environment* 90, 114–124.

Other significant publications:

1. Xiong, Y., **Bari, M.A.**, Xing, Z., Du, K., 2020. Ambient volatile organic compounds (VOCs) in two coastal cities in western Canada: Spatiotemporal variation, source apportionment, and health risk assessment. *Science of the Total Environment 706,* doi. 10.1016/ j.scitotenv.2019.135970.
2. **Bari, M.A.**, Kindzierski, W.B. (2015). Fifteen-year trends in criteria air pollutants in oil sands communities of Alberta, Canada. *Environment International* 74, 200–208.
3. **Bari, M.A.**, Baumbach, G., Kuch, B., Scheffknecht, G. (2009). Wood smoke as a source of particle-phase organic compounds in residential areas. *Atmospheric Environment* 43, 4722–4732.
4. **Bari, M.A.**, Kindzierski, W.B. (2016). Fine particulate matter ($PM_{2.5}$) in Edmonton, Canada: source apportionment and potential risk for human health. *Environmental Pollution* 218, 219–229.
5. **Bari, M.A.**, Kindzierski, W.B. (2018). Ambient volatile organic compounds (VOCs) in Calgary, Alberta: sources and screening health risk assessment. *Science of the Total Environment* 631–632, 627–640.

Synergistic Activities

1. *Professional Affiliation*

2017– present: Professional Engineer (P.Eng.) with the Association of Professional Engineers and Geoscientists of Alberta (APEGA), Canada

2018-members of the Association of Environmental Engineering and Science Professors (AEESP), the Air & Waste Management Association (A&WMA), and the American Association for Aerosol Research (AAAR)

2. Member of New York State MESONET (weather monitoring) Science Advisory Committee.
3. Journal service

Guest Editors for Special Issues (SI)

2020-2021: Special Issue "Pollutants in Indoor Air" in journal 'Pollutants'.

2020-2021: Special Issue "Advanced Technologies in Air Science: Monitoring, Analyzing, Modeling, and Implementation" in journal 'Atmosphere'..

2020: Special Issue "Sources, Spatiotemporal Variation and Potential Health Risk of Hazardous Air Pollutants" in journal 'Atmosphere'.

2019/20: Special Issue "Sustainable Air Pollution Management" in journal 'Sustainability'.

Topical Advisory Panel

2021: Journal "Toxics"(https://www.mdpi.com/journal/toxics/topic_editors)

4. Media: Recorded an "Academic Minute" spot for WAMC/NPR, Northeast Public Radio (2019). https://academicminute.org/2019/01/md-aynul-bari-university-at-albany-air-pollution-in-the-home/
5. Proposal Review
   - Received invitation for NSF Panel Review for Smart & Connected Communities (2022)
   - Reviewed proposal for Swiss National Science Foundation (2019)
   - Reviewed proposal for Health Canada's Clean Air Regulatory Agenda (CARA) Program (2017)

Co-PI: Scott Miller, Atmospheric Science Research Center, UAlbany

Research Associate
Atmospheric Sciences Research Center
State University of New York at Albany
http://asrc.albany.edu/people/faculty/miller

251 Fuller Road L317
Albany, NY 12203
(518) 437-8799
smiller@albany.edu

Professional Preparation

State University of New York at Buffalo	Mechanical Engineering	B.S. 1991
University of California at Irvine	Engineering	M.S. 1994
University of California at Irvine	Engineering	Ph.D. 1998
University of California at Irvine	Earth System Science	Postdoc, 1998-2003

Appointments

2005-Present	Research Associate, Atmospheric Sciences Research Center and Adjunct Professor of Atmospheric and Environmental Sciences, SUNY Albany
2003-2005	Assistant Researcher, Earth System Science, UC Irvine
1995	Graduate Teaching Assistant, Mechanical and Aerospace Engineering, UC Irvine
1991-1998	Graduate Research Assistant, Mechanical and Aerospace Engineering, UC Irvine
1989-1990	Engineering Intern, Hebeler Corporation, Buffalo, NY

Refereed Publications (5 closely Related)

Brotzge, J., J. Wang, C. D. Thorncroft, E. Joseph, N. Bain, N. Bassill, N. Farruggio, J. M. Freedman, K. Hemker Jr., D. Johnston, E. Kane, J. Minder, S. McKim, **S. D. Miller**, P. Naple, S. Perez, J. Schwab, and J. Sicker (2020), A Technical Overview of the New York State Mesonet Standard Network, J. Atmos. Ocean. Technol., 37, pp 1827-1845, DOI: 10.1175/JTECH-D-19-0220.1 .

Miller, S.D., M.L. Goulden, L.R. Hutyra, M. Keller, S.R. Saleska, S.C. Wofsy, A.M.S. Figueira, H.R. da Rocha, P.B. de Camargo (2011): Reduced Impact Logging Minimally Alters Tropical Rainforest Carbon and Energy Exchange, Proceedings of the National Academy of Sciences: doi: 10.1073/pnas.1105008108.

Figueira, A. M. e S., S. D. Miller, C. A. D de Sousa, M. C. Menton, A. R. Maia, H. R. da Rocha, and M. L. Goulden (2008): Effects of selective logging on tropical forest tree growth, J. Geophys. Res., 113, G00B05, doi:10.1029/2007JG000577.

Bruno, R.D., H.R. da Rocha, H. Freitas, M. Goulden, and S.D. Miller (2006): Soil moisture dynamics in an eastern Amazonian tropical forest. *Hydrol. Process.* **20**:2477-2489, DOI: 10.1002/hyp.6211.

Miller, S.D., M.L. Goulden, H.R. da Rocha (2007): The Effect of canopy gaps on subcanopy ventilation and scalar fluxes in a tropical forest, *Agr. Forest Meteorol.* **142**:25-34, doi:10.1016/j.agrformet.2006.10.008.

Refereed Publications (5 other significant)

Czikowsky, M.J., S. MacIntyre, E. Tedford, J. Vidal, and S.D. Miller (2018), Effects of wind and buoyancy on carbon dioxide distribution and air-water flux of a small temperate lake, JGR-Biogeosciences, 10.1029/2017JG004209.

Butterworth, B. J., and S. D. Miller (2016), Air-sea exchange of carbon dioxide in the Southern Ocean and Antarctic marginal ice zone, *Geophys. Res. Lett., 43*, doi:10.1002/2016GL069581.

Miller, S. D., C. Marandino, and E. S. Saltzman (2010): Ship-based measurement of air-sea CO_2 exchange by eddy covariance, J. Geophys. Res., 115, D02304, doi:10.1029/2009JD012193.

Miller, S.D., C.A. Marandino C.A., W.J.De Bruyn, and E.S. Saltzman (2009): Air-Sea Gas Exchange of CO_2 and DMS in the North Atlantic by Eddy Covariance, *Geophys. Res. Lett*, 36, L15816, doi:10.1029/2009GL038907.

Miller, S.D., T.S. Hristov, J.B. Edson, and C.A. Friehe (2008): Platform Motion Effects on Measurements of Turbulence and Air-Sea Exchange Over the Open Ocean, *J. Atmos. Ocean. Tech.* 25(9), 1683–1694, doi:10.1175/2008JTECHO547.1.

Synergistic Activities

2020- Atmospheric Sciences Research Center Communications & Outreach Committee
2019- New York State Mesonet Science Advisory Committee co-Chair
2014- UAlbany Department of Atmospheric and Environmental Sciences Graduate Program Committee

Co-PI: Sarah Lu, Atmospheric Science Research Center, UAlbany
ETEC Suite 496 – DAES, 1400 Washington Avenue, Albany, NY 12222
clu4@albany.edu; (518)-437-8700

Education and Training:

Institution	Major	Degree	Year
National Central University, Chung-Li, Taiwan	Atmospheric Physics	BS	1989
State University of New York at Albany, Albany NY	Atmospheric Sciences	MS	1992
State University of New York at Albany, Albany NY	Atmospheric Sciences	PhD	1998

Academic and Professional Appointments

2019-present Senior Research Scientist, Joint Center for Satellite Data Assimilation, Boulder, CO (50% appointment)

2019-present Research Associate, Atmospheric Sciences Research Center, University at Albany, State University of New York, Albany, NY (50% appointment)

2014-2019 Research Associate, Atmospheric Sciences Research Center, University at Albany, State University of New York, Albany, NY

2010-2014 Lead, Air Quality and Aerosol Modeling Support Task, I. M. Systems Group, Inc., Rockville, MD

2015-2010 Research Meteorologist, Science Applications International Corporation (SAIC), San Diego, CA

Relevant Publications and Recent (3-year) Publications:

Lu, C-H., Q. Liu, S.-W. Wei, B. T. Johnson, C. Dang, P. G. Stegmann, D. Grogan, G. Ge, and M. Hu, and M. Lueken, 2022: The Aerosol Module in the Community Radiative Transfer Model (v2.2 and v2.3): accounting for aerosol transmittance effects on the radiance observation operator, **Geosci. Model Dev.**, 15, 1317–1329, doi:10.5194/gmd-15-1317-2022

Couillard, M., M. J. Schwab, J. Schwab, C-H Lu, E. Joseph, B. Stutsrim, B. Shrestha, J. Zhang, T. Knepp, G. Gronoff, 2021: Vertical profiles of ozone concentrations in the lower troposphere downwind of New York City during LISTOS 2018-2019, **J. Geophys. Res**. **J. Geophys. Res**., Atmospheres, 126, e2021JD035108, doi:10.1029/2021JD035108

Hung, W.-T., C.-H. Lu, S. Alessandrini, R. Kumar, C.-A. Lin, 2021: The impacts of transported wildfire smoke aerosols on surface air quality in New York State: A multiple-year study using machine learning, **Atmos. Environ**., 259, 118513, doi:10.1016/j.atmosenv.2021.118513

Wei, S.-W., C-H Lu, Q. Liu, A. Collard, T. Zhu, D. Grogan, X. Li, J. Wang, R. Grumbine, and P/ S. Bhattacharjee, 2021: The impact of aerosols on satellite radiance data assimilation using NCEP global data assimilation system, **Atmos**., 12, 432. doi: 10.3390/atmos12040432.

Lin, C-A., C-H Lu, S-P. Chen, W.-T. Hung, K. Civerolo, O. V. Rattigan, 2021: Characterization of intra-continental smoke transport and impact on New York state air quality using aerosol reanalysis and multi-platform observation, **Atmos. Pollu. Res.,** 12, 154-166, doi: 10.1016/j.apr.2021.01.021.

Chen, Y.-C., S.-H. Wang, Q. Min, S. Lu, P.-L. Lin, N.-H. Lin, K.-S. Chung, E. Joseph, 2021: Aerosol impacts on warm-cloud microphysics and drizzle in a moderately polluted environment, **Atmos. Chem. Phys.**, 21, 4487-4502, doi:10.5194/acp-21-4487-2021.

Tang, Y., H. Bian, Z. Tao, L. D. Oman, D. Tong, P. Lee, P. Campbell, B. Baker, C.-H. Lu, L. Pan, J. Wang, J. McQueen, and I. Stajner, 2021: Comparison of Chemical Lateral Boundary

Conditions for Air Quality Predictions over the Contiguous United States during Intrusion Events, **Atmos. Chem. Phys.**, 21, 2527-2550, doi:10.5194/acp-21-2527-2021.

Hung, W.-To., C.-H. Lu, S. Alessandrini, R. Kumar, C.-A. Lin,2020: Estimation of PM2.5 concentrations in New York State: Understanding the influence of vertical mixing on surface PM2.5 using machine learning, **Atmos.**, 11, 1303, doi:10.3390/atmos11121303.

Ninneman, M., S. Lu, X. Zhou, J. Schwab, 2020: On the importance of surface-enhanced re-noxification as an oxides of nitrogen source in rural and urban New York State, **ACS Earth and Space Chem.**, 4, 11, 1985-1992, doi: 10.1021/acsearthspacechem.0c00185.

Hung W.-T., C-H Lu C.-H, B. Shrestha, H-C Lin, C-A Lin, D. Grogan, J. Hong, R. Ahmadov, E. James, and E. Joseph E, 2020: The impacts of transported wildfire smoke aerosols on surface air quality in New York State: A case study in summer 2018. **Atmos. Environ.** 227, 177415. doi: 10.1016/j.atmosenv.2020.117415.

Hung, W.-T., C.-H. Lu, S.-H. Wang, S.-P. Chen, F. Tsai, and C. C.-K. Chou, 2019: Investigation of long-range transported PM2.5 events over North Taiwan during 2005-2015 winter season, **Atmos. Environ.**, doi:10.1016/j.atmosenv.2019.116920.

Chen, S.-P., C.-H. Lu, J. McQueen, P. Lee, 2018: Application of satellite observations in conjunction with aerosol reanalysis to characterize long-range transport of African and Asian dust on air quality in the contiguous U.S., **Atmos. Environ**, doi: 10.1016/ j.atmosenv.2018.05.038.

Ninneman, M., S. Lu, P. Lee, J. McQueen, J. Huang, K. Demerjian, and J. Schwab, 2017: Observed and model-derived ozone production efficiency over urban and rural New York State, **Atmosphere**, 126, doi: 10.3390/atmos8070126.

Lee, P., J. McQueen, I. Stajner, J. Huang, L. Pan, D. Tong, H. Kim, Y. Tang, S. Kondragunta, M. Ruminski, S. Lu, E. Rogers, R. Saylor, P. Shafran, H.-C. Huang, J. Gorline, S. Upadhayay, and R. Artz, 2016: NAQFC developmental forecast guidance for fine particulate matter (PM2.5), **Wea Forecasting**, doi: 10.1175/WAF-D-15-0163.1.

Lu, C.-H., A. da Silva, J. Wang, S. Moorthi, M. Chin, P. Colarco, Y. Tang, P. S. Bhattacharjee, S.-P. Chen, H.-Y. Chuang, H-M. H. Juang, J. McQueen, and M. Iredell, 2016: The implementation of NEMS GFS Aerosol Component (NGAC) Version 1.0 for global dust forecasting at NOAA/NCEP, **Geo. Model Dev.**, 9, 1–37, doi:10.5194/gmdd-9-1-2016.

Lee, P., Y. Tang, D. Kang, J. McQueen, M. Tsidulko, H-C Huang, S. Lu, M. Hart, H-M Lin, S. Yu, G. DiMego, I. Stajner, P. Davidson, 2009: Impact of consistent boundary layer mixing approaches between NAM and CMAQ, **Environ. Fluid Mech.**, 9, 23-42.

Janjic, Z., H Huang, S. Lu, 2009: A unified atmospheric model suitable for studying transport of mineral aerosols from meso to global scale, WMO/GEO Expert Meeting on an International Sand and Dust Storm Warning System, **IOP Conf.Series: Earth and Environmental Science**, 7, 012011doi:10.1088/1755-1307/7/1/012011

Andreani-Aksoyoglu, A., C.-H. Lu, J. Keller, A. Prevot, and J.S. Chang. 2001: Variability of indicator values for ozone production sensitivity: A model study in Switzerland and San Joaquin Valley (California), **Atmos. Environ.**, 35, 5593-5604, 2001.

Lu, C.-H., and J.S. Chang, 1998: On the indicator-based approach to assess ozone sensitivities and emission features, **J. Geophys. Res.**, 103, 3453-3462.

Co-PI: Brian Pavilonis, City University of New York (CUNY), School of Public Health

NAME: Brian Pavilonis

eRA COMMONS USER NAME (credential, e.g., agency login): bpavilon

POSITION TITLE: Associate Professor

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.)*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	Completion Date MM/YYYY	FIELD OF STUDY
The University of Iowa, Iowa City, IA	BS	2001-2005	Environmental Chemical Sciences
The University of Illinois, Springfield, IL	MPH	2006-2008	Environmental Health
The University of Iowa, Iowa City, IA	PhD	2008-2012	Occupational and Environmental Health
Rutgers University, Piscataway, NJ	Postdoctoral	2012-2014	Exposure Science

A. Personal Statement

The overarching goal of this three-year project is to improve air quality and public health across underserved neighborhoods in New York State by establishing a community-driven network platform to enhance understanding of sustainable outdoor and indoor air quality. Currently, I am an Associate Professor in the Department of Environmental, Occupational, and Geospatial Health Sciences at the CUNY Graduate School of Public Health and Health Policy, Certified Industrial Hygienist, and Industrial Hygiene Program Director for the NY/NJ ERC. As PI and co-investigator on several environment health studies, I have laid the groundwork for the proposed research by developing methods for analyzing various exposure data and recruiting within underserved populations. For the proposed project, I will recruit participants to conduct air sampling in their homes as well as supervise ambient monitoring sites located in New York City.

The current application builds upon my research in exposure science and air quality:

1. Pavilonis, B. T., Anthony, T. R., O'Shaughnessy, P. T., Humann, M. J., Merchant, J. A., Moore, G., ... & Sanderson, W. T. (2013). Indoor and outdoor particulate matter and endotoxin concentrations in an intensely agricultural county. *Journal of exposure science & environmental epidemiology*, *23*(3), 299-305.
2. Pavilonis, B. T., & Mirer, F. E. (2017). Respirable dust and silica exposure among World Trade Center cleanup workers. *Journal of Occupational and Environmental Hygiene*, *14*(3), 187-194.
3. Maroko, Andrew R., and Brian T. Pavilonis. "Occupational Groups and Environmental Justice: A Case Study in the Bronx, New York." Preventing chronic disease 15 (2018).
4. Myers, N. T., Calderón, L., Pavilonis, B., Wang, Z., Xiong, Y., Sorensen-Allacci, M., ... & Mainelis, G. (2021). Presence and variability of culturable bioaerosols in three multi-

family apartment buildings with different ventilation systems in the Northeastern US. *Indoor air*, *31*(2), 502-523.

5. Pavilonis, B., Ierardi, A. M., Levine, L., Mirer, F., & Kelvin, E. A. (2021). Estimating aerosol transmission risk of SARS-CoV-2 in New York City public schools during reopening. *Environmental Research*, *195*, 110805.

B. Positions and Honors

Positions and Employment

2012-2014 NIEHS Post-doctoral Fellow, Environmental and Occupational Health Sciences Institute, Rutgers University, Piscataway, NJ
2014-2021 Assistant Professor, CUNY School of Public Health, New York, NY
2021-present Associate Professor, CUNY School of Public Health, New York, NY

Other Experience and Professional Memberships

2017 - Certified Industrial Hygienist, American Board of Industrial Hygiene (ABIH)
2008 - American Industrial Hygiene Association

Honors

2017 CUNY SPH Dean's Excellence in Teaching

Complete List of my Published Work

https://scholar.google.com/citations?user=q_qZQcIAAAAJ&hl=en&oi=ao

C. Research Support

Ongoing Research Support

NIEHS 1R25ES033044-01 Pavilonis (co-PI)
(9/22/2021-8/31/2026)
Add significant new training and research opportunities for industrial hygiene students at the CUNY SPH in the hands-on use of sensor technology and laboratory.
Role: Contact PI / Co-PI

NIOSH 2T42OH008422-16 Meyer (PI)
(7/1/2021-6/30/2027)
The mission of the NYNJERC is to assure safe and healthful working conditions for working men and women by preparing the next generation of professional leaders in OSH through training programs that equip graduates with the knowledge, skills, and attitudes that they will need to understand, evaluate, prevent, manage, and treat occupational disease and injury in the workers of its region and across the United States.
Role: Subcontract PI

PSC CUNY Pavilonis (co-PI)
(7/1/2020-7/1/2022)
Determine the ecological association between soil lead levels and elevated blood lead levels in children.
Role: co-PI

Subawardee: M. Elias Dueker, Bard College
Associate Professor
Biology Program, Environmental and Urban Studies (EUS) Program
Bard College
30 Campus Road, Annandale-On-Hudson, NY 12504
Phone: (845)752-2338, Email: edueker@bard.edu

Education

Ph. D.	Columbia University Department of Earth and Environmental Sciences Cary Institute of Ecosystem Studies (affiliated graduate student)	2012
M. Phil.	Columbia University Department of Earth and Environmental Sciences	2009
M. A.	Columbia University Department of Earth and Environmental Sciences	2008
B. A.	Rhodes College English Department	1992

Academic Appointments

Associate Professor, Bard College	2020 – present
Assistant Professor, Bard College	2014--2020
Visiting Research Scientist, Cary Institute of Ecosystem Studies	2014 – 2020
Associate Research Scientist, CUNY Queens College	2014 – 2018
Postdoctoral Research Scientist, CUNY Queens College	2013 – 2014
Adjunct Instructor, Environmental Studies Program, New York University	2013
Postdoctoral Research Scientist, Lamont-Doherty Earth Observatory	2012 – 2013

Selected Community Leadership Positions

Board Member, Roe Jan Watershed Community	2018 - present
Co-founder, Hudson River Subwatershed and Tributary Research Network	2017 -present
Board Member, Sustainable Hudson Valley	2019 - 2021
Board Member, Hudson River Watershed Alliance	2019 - 2021
Board Member, Hudson River Environmental Society	2017 - 2019

Selected Awards

- Open Society University Network ($1,300,000): "Global Community Science Coalition," 2020
- IDEXX, inc. Labs ($6,200): "Tracking *Legionella pneumophila* in urban and rural streams," 2019
- NYS DEC ($45,000): "Building the Hudson River and Sub-Tributaries Research Network (THuRST)," Lead PI: Kate Meierdiercks (Sienna College), 2018
- Watershed WaveMaker Award from Hudson River Watershed Alliance (recognizing the Bard Water Lab and Saw Kill Watershed Community), 2017
- NYS DEC ($48,297): "Science-based development of Saw Kill Watershed Community (Phase II)," 2017
- NYS DEC ($45,297): "Science-based development of Saw Kill Watershed group,"2015
- Red Hook Conservation Advisory Council ($325): support for the Saw Kill Monitoring Program, 2014
- Hudson River Foundation Rapid Response Fund ($9,175): "Seed-funding for Bard Water Lab," 2015

- Hudson River Foundation Research Fund ($180,000): "Sewage loading to the Hudson River as a determinant of microbial air quality: exploration of public health connections and monitoring approaches," co-PI: Gregory O'Mullan (CUNY Queens), 2013
- City University of New York Postdoctoral Travel Award Program ($1,000): funding to present "Onshore winds and coastal fog enhance bacterial connections between water and air in the coastal environment" at American Geophysical Union (AGU) Conference, 2013
- Janet Holden Adams Fund ($2,300): "Deep-sequencing of microbes in coastal fog," 2013
- Hudson River Foundation Rapid Response Grant ($10,400): "Post-Superstorm Sandy collection and analysis of samples from flood impacted areas," 2012

Selected Publications (* = undergraduate researcher)

- **Dueker, M. E.**, S. G. French*, G. D. O'Mullan (2018). Comparison of bacterial diversity in air and water of a major urban center *Frontiers in Microbiology* 9(2868). doi: 10.3389/fmicb.2018.02868.
- Evans, S. E. and **Dueker, M. E.** (co-lead-authors), R. Logan, K. C. Weathers (2018). The biology of fog: results from coastal Maine and Namib Desert reveal common drivers of fog microbial composition. *Science of the Total Environment* 647(1547-1556).
- **Dueker, M. E.**, Gregory D. O'Mullan, Joaquín Martínez Martínez, Andrew R. Juhl, and Kathleen C. Weathers (2017). Onshore wind speed modulates microbial aerosols along an urban waterfront. *Atmosphere* 8(11): 215; doi:10.3390/atmos8110215.
- O'Mullan, G. D., **M. E. Dueker** and A. R. Juhl (2017). Challenges to managing microbial fecal pollution in coastal environments: extra-enteric ecology and microbial exchange among water, sediment, and air. *Current Pollution Reports* 3(1): 1-16.
- Montero, A.*, **M. E. Dueker** and G. D. O'Mullan (2016). Culturable bioaerosols along an urban waterfront are primarily associated with coarse particles. *PeerJ* 4: e2827.
- O'Mullan, G. D., **M. E. Dueker**, K. Clauson*, Q. Yang, K. Umemoto*, N. Zakharova, J. Matter, M. Stute, T. Takahashi, D. Goldberg (2015). Microbial stimulation and succession following a test well injection simulating CO_2 leakage into a shallow Newark Basin aquifer. *PLOS One*, 10.1371/journal.pone.0117812.
- **Dueker, M. E.**, G.D. O'Mullan (2014). Aeration remediation of a polluted waterway increases near-surface coarse and culturable microbial aerosols. doi: 10.1016/j.scitotenv.2014.01.092. *Science of the Total Environment*, 478:184-189.
- **Dueker, M. E.**, G.D. O'Mullan, A.R. Juhl, K. C. Weathers, M. Uriarte (2012). Local environmental pollution strongly influences culturable bacterial aerosols at an urban aquatic Superfund site. *Environmental Science & Technology*, 46 (20): 10926-10933.
- **Dueker, M. E.**, G.D. O'Mullan, K. C. Weathers, A.R. Juhl, M. Uriarte (2011). Coupling of fog and marine microbial content in the near-shore coastal environment. *Biogeosciences*, 9 (2): 803-814.
- **Dueker, M. E.**, K. C. Weathers, G.D. O'Mullan, A.R. Juhl, M. Uriarte (2011). Environmental controls on coastal coarse aerosols: implications for microbial content and deposition in the near-shore environment. *Environmental Science & Technology*, 45(8): 3386-3392.

Senior Personnel: Zahirul Hasan Khan, University at Albany
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Education
B.Sc. Mechanical Engineering, Bangladesh University of Engineering & Technology, 1992
P.G.D. in Computer Science, Bangladesh Institute of Management, Bangladesh, 1999
M.S. in Mechanical Engineering, Ohio University, USA, 2002
Ph.D. in Integrated Engineering, Ohio University, USA, 2007
M.Eng. in Engineering Management, University of Ottawa, Canada, 2015

Personal Statement Related to the Project
I have more than 15 years of research experience on pollution control, Green House Gas (GHG) reduction and air quality improvement. My Masters research was on Ohio University's patented technology membrane based electrostatic precipitator (ESP) to investigate the feasibility of dry membrane based electrostatic precipitator, funded by U.S. Environmental Protection Agency (EPA). My doctoral research on Sieving Electrostatic Precipitator patented by Ohio University was controlling/capturing fine particulate matters and reduction of toxic vapors and other trace elements. I am one of the inventors of "Hot Sieving Electrostatic Precipitator" specially developed to use for burning high sulfur content low grade Canadian Oil sands. Currently, I am working in several projects (funded and unfunded) with PI Bari on improving air quality (both indoor and outdoor) as a Key Personnel of the projects. I will be working on this EPA project if funded and will provide my expertise on from community engagement to developing building capacity and empowering communities.

Appointments
Research Scientist, Zero Emission Technologies (ZET) Research group, Natural Resources Canada, 2007-2008
Post-doctoral fellow, ZET Research group, Natural Resources Canada, 2008-2011
Research Scientist, ZET Research group, Natural Resources Canada, 2011-2013
Founding President, HRZ Research & Consultancy, Ottawa, Canada, 2013-2017
Lead Researcher, University of Ottawa, Canada, 05-2017-08 -2017
Adjunct Professor, University at Albany, SUNY, 08-2019- present

Current Membership in Professional Organizations
Electrostatic Society of America (ESA)
American Society of Mechanical Engineer (ASME)
Association of Business Communication (ABC)

Honors and Awards
Top Paper Award in Business Communication at NCA Convention (2017)
NSERC Postdoctoral Visiting Fellowship Award (2008 – 2011)
NSF Conference Poster Competition Award (2006)

Electrostatic Society of America Student Paper competition Award (2005)
First Place, 4th Annual Research and Creative Activity Fair, Ohio University (2005)

Service Activities

Mentor, University at Albany Summer Research Program, 2021-
Reviewer, IGA Global, 2019-
Mentor, IEEE Engineering Projects in Community Service (EPICS) Challenge
-My mentees, senior high school students, are the First place winner of 2018 IEEE EPICS Challenge
Mentor, Tech Valley Centre of Gravity, Troy, NY, 2018-
-Mentoring eight groups of senior high school students for their 40 weeks long capstone project
Journal Manuscript Reviewer, Journal of Electrostatics: 2017-present
Judge, Student paper/poster competition, Joint Electrostatics Conference (2017)
City of Ottawa's Environmental Stewardship Advisory Committee member (2013-2014)

Important Publications and Presentations

Zanganeh, K., **Khan, Z. H**., Salvador, C., Jensen, J., "Hot Sieving Electrostatic Precipitator," Patent number WO 20011/006262 A1 and US 20120111188A1.

Paul, S., Eugene, M., Pereira, R., **Khan, Z.H.**, Bari, M.A., 2022. Understanding heterogeneity and sources of black carbon in residential neighbourhoods in the Capital Region of New York State. Abstract in the Air Sensors International Conference, Pasadena, CA, May 11–13.

Khan, Z.H., Bari, Aynul, & Paul, Sanchita, "Indoor Air Quality Improvement: A Systematic Literature Review on Particulate Matter, and Indoor Air Toxics Control" Proceedings 2018 Electrostatic Society of America Annual Meeting, Conference, June 10-12, 2017, Rochester, New York, USA.

Khan, Z.H., Bouzianas, G.D. et al, . "A Comparative Study of Experimental and Simulation Results of Sieving Electrostatic Precipitator," Proceedings 2017 Electrostatic Society of America Annual Meeting, Conference, June 12-15, 2017, University of Ottawa, Ontario, Canada.

Khan, Z. H., "The Development of Modern Discharge Electrode in Electrostatic Precipitation: A Systematic Review," in 2016 Joint Electrostatics Conference, June 13-16, 2016, Purdue University, IN, USA.

Khan, Z. H., Zanganeh, K., Salvador, C. "Experimental Study of Dielectric Breakdown of Refractory Board Materials for Application in High-temperature Sieving Electrostatic Precipitator," Proceedings 2012 Joint Electrostatics Conference, June 12-14, 2012, Waterloo, Ontario, Canada.

Recent Professional Development Activities

Selected and invited to attend 2019-2020 proposal writing workshop at University at Albany
Attended Electrostatic Society of America Annual Conference in Rochester, NY, June 2018
Attended Electrostatic Society of America Annual Conference at the University of Ottawa, Canada, June 2017
Attended Joint Electrostatics Conference at Purdue University, IN, June 2016